Unit-3

Number System

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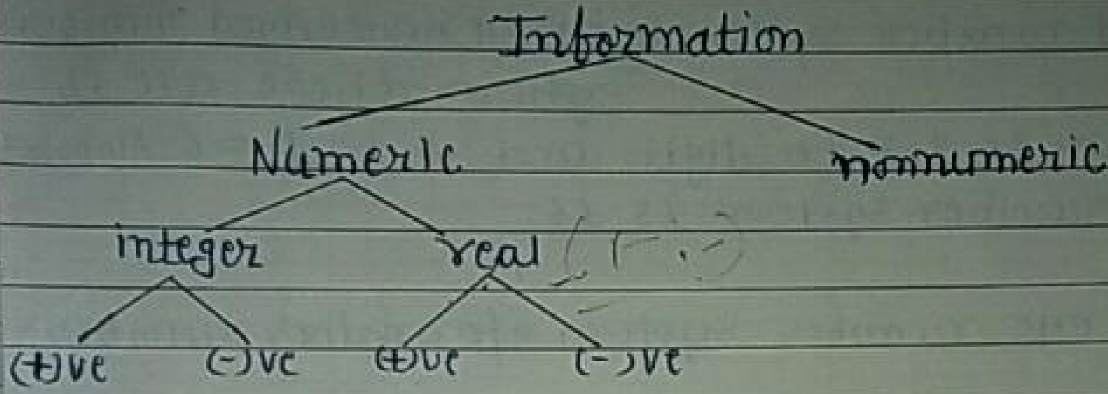

to represent all these numeric information we have four types of number system.

i.) Binary number system.
ii.) octal number system.
iii.) Decimal number system.
iv.) Hexadecimal number system.

i.) Binary number system :- in Binary number system there are only two digits there are 0 or 1. zero represent -5 Voltage. one (1) represent +5 Voltage. these digits are also known as bit which is unit of memory. Base of these number system is 2. and Base is also know as radix.

MSB , LSB

ii.) Octal number system :- in octal number system there are eight digits. from 0 to 7 and base of these numer system is 8.

MSD , LSD

iii.) Decimal number system :- in decimal number system there are 10 digits from 0 to 9 and base of these number system is 10

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iv) Hexadecimal number system :- in Hexadecimal number system there are 16 symbol from 0 to 9 = 10 digits and A to F = 6 Alphabets and base of number system is 16.

Conversion of one number system to another number system.

① Decimal to any base ⇒ $( )_{10} \longrightarrow ( )_?$

1.1 $( )_{10} \longrightarrow ( )_2$

1.2 $( )_{10} \longrightarrow ( )_8$

1.3 $( )_{10} \longrightarrow ( )_{16}$

2) Any base to decimal ⇒ $( )_? \longrightarrow ( )_{10}$

2.1 $( )_2 \longrightarrow ( )_{10}$

2.2 $( )_8 \longrightarrow ( )_{10}$

2.3 $( )_{16} \longrightarrow ( )_{10}$

3) Binary to Octal ⇒ $( )_2 \longrightarrow ( )_8$

4) Binary to Hexadecimal ⇒ $( )_2 \longrightarrow ( )_{16}$

5) Octal to Binary ⇒ $( )_8 \longrightarrow ( )_2$

6) Hexadecimal to Binary ⇒ $( )_{16} \longrightarrow ( )_2$

7) Octal to Hexadecimal ⇒ $( )_8 \longrightarrow ( )_{16}$

8) Hexadecimal to octal ⇒ $( )_{16} \longrightarrow ( )_8$

9) Any base to Any base ⇒ $( )_? \longrightarrow ( )_?$

$2^7 = 128$

ASCII - American Standard Code for information Interchange

$2^8 = 256$

EBCDIC - Extended Binary Coded Decimal interchange Code

1.1 ~~Binary~~ Decimal to any base

1.1.1 $(\ )_{10} \longrightarrow (\ )_2$

for integer :- (a) $(25)_{10} \to (\ )_2 = (11001)_2$

2	17	1
2	8	0
2	4	
2	2	1
	1	

(1001)

2	25	1	→ LSB
2	12	0	
2	6	0	
2	3	1	
2	1	1	→ MSB
	0		

$(25)_{10} \longrightarrow (11001)_2$

(b) $(365)_{10} \longrightarrow (\ )_2$

2	365	1	→ LSB
2	182	0	
2	91	1	
2	45	1	
2	22	0	
2	11	1	
2	5	1	
2	2	0	
2	1	1	→ MSB

$(365)_{10} \longrightarrow (101101101)_2$ Ans

(c) $(1005)_{10} \longrightarrow (\ )_2$

2	1005	1	→ LSB
2	502	0	
2	251	1	
2	125	1	
2	62	0	
2	31	1	
2	15	1	
2	7	1	
2	3	1	
2	1	1	→ MSB

$(1005)_{10} \longrightarrow (1111101101$ Ans

For friction:-

(a) $(.25)_{10} \longrightarrow (\ )_2$

$.25 \times 2 = 0.50 \longrightarrow 0 \longrightarrow$ MSB

$.50 \times 2 = 1.00 \longrightarrow 1 \longrightarrow$ LSB

$(.25)_{10} \longrightarrow (.01)_2$ Ans ⇒

(b) $(.46)_{10} \longrightarrow (\ )_2$

$.46 \times 2 = 0.92 \longrightarrow 0 \longrightarrow$ MSB

$.92 \times 2 = 1.84 \longrightarrow 1$

$.84 \times 2 = 1.68 \longrightarrow 1$

$.68 \times 2 = 1.36 \longrightarrow 1 \longrightarrow$ LSB

$(.46)_{10} \longrightarrow (.0111)_2$ Ans ⇒

(c) $(.40)_{10} \longrightarrow (\ )_2$

$.40 \times 2 = 0.80 \longrightarrow 0 \longrightarrow$ MSB

$.80 \times 2 = 1.60 \longrightarrow 1$

$.60 \times 2 = 1.20 \longrightarrow 1$

$.20 \times 2 = 0.40 \longrightarrow 0 \longrightarrow$ LSB

$(.40)_{10} \longrightarrow (.0110)_{10}$ Ans.

1.2) Decimal to octal

For integer (a) $(25)_{10} \longrightarrow (\;)_8$

8	25	1	$\longrightarrow$ LSD $\uparrow$
8	3	3	$\longrightarrow$ MSD
	0		

$(25)_{10} \longrightarrow (31)_8$ Ans

(b) $(96)_{10} \longrightarrow (\;)_8$

8	96	0	$\longrightarrow$ LSD $\uparrow$
8	12	4	
8	1	1	$\longrightarrow$ MSD
	0		

$(96)_{10} \longrightarrow (140)_2$ Ans.

(c) $(763)_{10} \longrightarrow (\;)_8$

8	763	3	$\rightarrow$ LSD $\uparrow$
8	95	7	
8	11	3	
8	1	1	$\rightarrow$ MSD
	0		

$(763)_{10} \longrightarrow (1373)_2$ Ans

For frictional :- (a) $(.26)_{10} \longrightarrow (\;)_8$

$.26 \times 8 \longrightarrow 2.08 \longrightarrow 2$ (MSD) $\downarrow$

$.08 \times 8 \longrightarrow 0.64 \longrightarrow 0$ (LSD)

$(.26)_{10} \longrightarrow (.20)_8$ Ans.

(b) $(.80)_{10} \longrightarrow (\;)_8$

$.80 \times 8 \Longrightarrow 6.40 \longrightarrow 6 \longrightarrow$ MSD $\downarrow$

$.40 \times 8 = 3.20 \longrightarrow 3 \longrightarrow$ LSD

$(.80)_{10} \rightarrow (.63)_8$ Ans...

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1.3 Decimal to Hexadecimal.

For integer :- (a) $(27)_{10} \rightarrow (\ )_{16}$

16	27	11 → B	→ LSD ↑
16	1	1	→ MSD
	0		

$\therefore (27)_{10} \rightarrow (1B)_{16}$ Ans ⇒

(b) $(125)_{10} \rightarrow (\ )_{16}$

16	125	13 → D	→ LSD ↑
16	7	7	→ MSD
	0		

$(125)_{10} \rightarrow (7D)_{16}$ Ans

For Frictional :- (a) $(.25)_{10} \rightarrow (\ )_{16}$

$.25 \times 16 = 4.00 \rightarrow 4$ ↓ → MSD (LSD)

~~.00 × 16 = 0.00 → 0~~

$(.25)_{10} \rightarrow (.4\cancel{0})_{16}$ Ans

(b) $(.18)_{10} \rightarrow (\ )_{16}$

$.18 \times 16 = 2.88 \rightarrow 2$ → MSD ↓

$.88 \times 16 = 14.08 \rightarrow 14\ (E)$ → LSD

$(.18)_{10} \rightarrow (.2E)_{16}$ Ans

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(2) Any base to Decimal (2.1) Binary to decimal

For integer (a) $(1011)_2 \longrightarrow (\ )_{10}$

$$1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$$
$$1\times8 + 1\times0 + 1\times2 + 1\times1$$
$$8 + 0 + 2 + 1$$
$(11)_{10}$ Ans

(b) $(11101)_2 \longrightarrow (\ )_{10}$

$$1\times2^4 + 1\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0$$
$$1\times16 + 1\times8 + 1\times4 + 0\times2 + 1\times1$$
$$16 + 8 + 4 + 0 + 1$$
$(29)_{16}$ Ans

(c) $(101011)_2$

$$1\times2^5 + 0\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$$
$$1\times32 + 0\times16 + 1\times8 + 0\times4 + 1\times2 + 1\times1$$
$$32 + 0 + 8 + 0 + 2 + 1$$
$(43)_{10}$ An

For Frictional:- (a) $(.101)_2 \longrightarrow (\ )_{10}$

$$1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3}$$
$$1\times\frac{1}{2} + 0\times\frac{1}{4} + 1\times\frac{1}{8}$$
$$\frac{1}{2} + \frac{1}{8}$$
$$\frac{4+1}{8} = \frac{5}{8}$$
$(0.62)_{10}$

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(b) $(.1101)_2$

Sol $\Rightarrow$ $1\times2^{-1} + 1\times2^{-2} + 0\times2^{-3} + 1\times2^{-4}$

$1\times\frac{1}{2} + 1\times\frac{1}{4} + 0\times\frac{1}{8} + 1\times\frac{1}{16}$.

$\frac{1}{2} + \frac{1}{4} + 0 + \frac{1}{16}$

$\frac{8+4+1}{16} = \frac{13}{16}$

$(.81)_{10}$ Ans $\Rightarrow$

(c) $(.011)_2$

Sol $\Rightarrow$ $0\times2^{-1} + 1\times2^{-2} + 1\times2^{-3}$

$0\times\frac{1}{2} + 1\times\frac{1}{4} + 1\times\frac{1}{8}$

$0 + \frac{1}{4} + \frac{1}{8}$

$\frac{2+1}{4} = \frac{3}{8}$

$(.37)_{10}$ Ans

2.2.1 Octal to Decimal

For integer (a) $(63)_8 \longrightarrow (\ )_{10}$

$6\times8^1 + 3\times8^0$

$48 + 3$

$(51)_{10}$

(b) $(203)_8 \longrightarrow (\ )_{10}$

$2\times8^2 + 0\times8^1 + 3\times8^0$

$128 + 3$

$(131)_{10}$

(c) $(93)_8 \longrightarrow (\ )_{10}$

information is wrong Ans.

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for friction: (a) $(.23)_8 \longrightarrow (\ )_{10}$

$2 \times 8^{-1} + 3 \times 8^{-2}$

$2 \times \frac{1}{8} + 3 \times \frac{1}{64}$

$\frac{1}{8} + \frac{3}{64}$

$\frac{19}{64}$

$(.29)_{10}$ Ans

(b) $(.110)_8 \rightarrow (\ )_{10}$

$1 \times 8^{-1} + 1 \times 8^{-2} + 0 \times 8^{-3}$

$1 \times \frac{1}{8} + 1 \times \frac{1}{64} + 0 \times \frac{1}{512}$

$\frac{9}{64}$

$(.14)_{10}$ Ans

2.3.) Hexadecimal to decimal

for integer:

(a) $(63)_{16} \rightarrow (\ )_{10}$

Sol: $6 \times 16^1 + 3 \times 16^0$

$\Rightarrow 96 + 3$

$\Rightarrow (99)_{10}$ Ans

(b) $(B99)_{16} = (\ )_{10}$

$B \times 16^2 + 9 \times 16^1 + 9 \times 16^0$

$11 \times 256 + 9 \times 16 + 9 \times 1$

$2816 + 144 + 9$

$(2969)_{16}$ Ans

For Friction:

(a) $(.F)_{16} \longrightarrow (\ )_{10}$

$(.14)_{16} \longrightarrow (\ )_{10}$

$1 \times 16^{-1} + 4 \times 16^{-2}$

$1 \times \frac{1}{16} + \frac{4}{256}$

$\frac{1}{16} + \frac{4}{256}$

$\frac{20}{256}$

$(.07)_{10}$ Ans

(b) $(.06)_{16} \longrightarrow (\ )_{10}$

$\Rightarrow 1 \times 16^{-1} + 6 \times 16^{-2}$

$\Rightarrow 1 \times \frac{1}{16} + 6 \times \frac{1}{256}$

$\Rightarrow \frac{1}{16} + \frac{6}{256}$

$\Rightarrow \frac{22}{256} = (.002)_{10}$

$\Rightarrow (.08)_{10}$ Ans

$(2)^4$

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2 Bit	octal	3 Bit ($(2)^3$, base-8 – 4 2 1)	Decimal	4 Bit (8 4 2 1)	Hexadecimal
00	0	000	0	0000	0
01	1	001	1	0001	1
10	2	010	2	0010	2
11	3	011	3	0011	3
	4	100	4	0100	4
	5	101	5	0101	5
	6	110	6	0110	6
	7	111	7	0111	7
			8	1000	8
			9	1001	9
			10	1010	A
			11	1011	B
			12	1100	C
			13	1101	D
			14	1110	E
			15	1111	F

No-3 to No-9 to change

to represent conversion of one number system to math number system we use two method.

i.) Direct method ii.) Shortcut method

in Direct method first we convert given number into decimal number then convert decimal number to given base.

3.1 Binary to octal
3.1 Direct method

(a) $(11011)_2 \longrightarrow (\ )_8$

$\cancel{1\times 8^4 + 1\times 8^3 + 0\times 8^2 + 1\times 8^1 + 1\times 8^0}$
$\cancel{1\times 4096}$

$1\times 2^4 + 1\times 2^3 + 0\times 2^2 + 1\times 2^1 + 1\times 2^0$

$1\times 16 + 1\times 8 + 0\times 4 + 1\times 2 + 1\times 1$

$16 + 8 + 0 + 2 + 1$

$(27)_{10}$

8	27	3	$\longrightarrow$ LSD ↑
8	3	3	$\longrightarrow$ MSD
	0		

$(27)_{10} \longrightarrow (33)_8$

(b) $(11.01)_2 \longrightarrow (\ )_8$

$1\times 2^1 + 1\times 2^0 \quad\quad 0\times 2^{-1} + 1\times 2^{-2}$

$2 + 1 \quad\quad 0 + \frac{1}{4}$

$3 \quad\quad .25$

$(11.01)_2 \longrightarrow (3.25)_{10}$

8	3	3
	0	

$.25 \times 8 = 2.00 \longrightarrow 2$

$(3.25)_{10} \longrightarrow (3.2)_8$ Ans

Shortcut method

3.2.) to convert given Binary number to its equivalent octal number first we make a group of three bit from LSB to MSB for integer and MSB to LSB for frictional than replace each three bit group two its equivalent octal number

(a) $(110111)_2 \longrightarrow (\ )_8$

~~(110111)~~ 110 111

Replace

110 6
111 7

$(110111)_2 \longrightarrow (67)_8$ Ans.

(b) $(1111101.10111)_2 \longrightarrow (\ )_8$

001 111 101 . 101 110

Replace

001 1
111 7
101 5

101 5
110 6

$(1111101.10111)_2 \longrightarrow (175.56)$

4. Binary to Hexadecimal :-

4.1. Direct method :-

(a) $(111101)_2 \longrightarrow (\ )_{16}$

$1\times2^5+1\times2^4+1\times2^3+1\times2^2+0\times2^1+1\times2^0$

$32+16+8+4+0+1$

61

$(111101)_2 \longrightarrow (61)_{10}$

$$\begin{array}{c|c|l}
16 & 61 & 13 \rightarrow D \\
\hline
16 & 3 & 3 \\
 & 0 &
\end{array}$$

↑ LSD, MSD

$(61)_{10} \longrightarrow (3D)_{16}$ Ans.

(b) $(110.110)_2 \longrightarrow (\ )_{16}$

$1\times2^2+1\times2^1+0\times2^0.$ $\quad 1\times2^{-1}+1\times2^{-2}+0\times2^{-3}$

$4+2$ $\quad \frac{1}{2}+\frac{1}{4}+0 \Rightarrow \frac{3}{4} \Rightarrow .75$

6

$(110.110)_2 \longrightarrow (6.75)_{10}$

$$\begin{array}{c|c|l}
16 & 6 & 6 \\
\hline
 & 0 &
\end{array}$$

$.75\times16 = 12.0 \rightarrow 1$ ↓ → MSD

$.20\times16 = 3.20 \rightarrow 3$ → LSD

$(6.75)_{10} \longrightarrow (6.13).$

$(6.75)_{10} \longrightarrow (6.D)$ Ans

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4.2.) Shortcut Method:- to convert given binary no. to its equivalent hexadecimal number first we make a ~~integer~~ LSB to MSB ~~MSB~~ to ~~LSB~~ MSB group of four bit from replace each for frictional MSB ~~LSB~~ to LSB then its equivalent hexadecimal four ~~three~~ bit group to its equivalent

(a) $(1101101)_2 \longrightarrow (\ )_{16}$

0110 1101
$\longleftarrow$ Replace

$0110 \rightarrow 6$
$1101 \rightarrow D$

$(01101101)_2 \longrightarrow (6D)_{16}$ Ans

(b) $(11101.11011)_2 \longrightarrow (\ )_{16}$

00011101 . 11011000
$\longleftarrow$ Replace $\longrightarrow$

$0001 \rightarrow 1$
$1101 \rightarrow D$

$(11101.11011)_2 \longrightarrow (1D)_{16}$ Ans

5.1 octal to Binary

5.1.1 Direct method

(a) $(67)_8 \longrightarrow (\ )_2$

$6\times 8^1 + 7\times 8^0$

$48 + 7$

55

$(67)_8 \longrightarrow (55)_{10}$

2	55	1	$\longrightarrow$ LSB
2	27	1	
2	13	1	
2	6	0	
2	3	1	
2	1	1	$\longrightarrow$ MSB
	0		

$(55)_{10} \longrightarrow (110111)_2$

(b) $(29.63)_8 \longrightarrow (\ )_2$

ms ⇒ information is wrong.

5.2) Shortcut method → to convert to its equivalent Binary to its given octal number we replace each digit of given octal number to its equivalent Binary digit.

(a) $(237)_8 \longrightarrow (\ )_2$

Replace

2 by 010

3 by 011

7 by 111

$(237)_8 \longrightarrow (010011111)_2$ Ans

(b) $(1101.43)_8 \longrightarrow (\ )_2$

Replace

1 by 001

0 by 000

4 by 100

3 by 011

$(1101.43) \longrightarrow (001001000011.100011)_2$

(c) $(683.12)_8 \longrightarrow (\ )_2$

information is wrong

6.) Hexadecimal to Binary

6.1) Direct method.

(a) $(69)_{16} \longrightarrow ()_2 \longrightarrow (1101001)_2$

Sol → $6 \times 16^1 + 9 \times 16^0$

$96 + 9$

105

$(105)_{16} \longrightarrow (\cancel{105})_{10}$

$(69)_{16} \longrightarrow (105)_{10}$

2	105	1	LSD
2	52	0	
2	26	0	
2	13	1	
2	6	0	
2	3	1	
2	1	1	MSD
	0		

$(105)_{10} \longrightarrow (1100111)_2$ or ~~$(11101111.01000)_2$~~

(b) $(EF.4)_{16} \longrightarrow ()_2$ $(11101111.01000)_2$

(~~1516~~ 4) EF

Sol:

~~1415~~

~~$1 \times 16^3 + 4 \times 16^2 + 1 \times 16^1 + 1 \times 16^0$~~

~~$4096 + 1024 + 16$~~

$= E \times 16^1 + F \times 16^0$

$= 14 \times 16 + 15 \times 1$

$= 224 + 15$

$= 239$

$= .4$

$= 4 \times 16^{-1}$

$= \frac{4}{16}$

$= 0.25$

2	239	1 → LSD	
2	119	1	
2	59	1	
2	29	1	
2	14	0	
2	7	1	
2	3	1	
2	1	1	MSD
	0		

$(239.25)_{16} \longrightarrow (11101111.01)_2$ or

$.25 \times 2 = 0.50 \rightarrow 0$

$.50 \times 2 = 1.00 \rightarrow 1$

6.2) Shortcut method :- to convert given hexa number to it's equivalent binary number we replace each digits of given hexa number to its equivalent binary number.

(a) $(B64)_{16} \longrightarrow (\;)_2 \rightarrow (1011\,0110\,0100)_2$

(b) $(2C.9F)_{16} \longrightarrow$

Replace

B by 1011

6 by 0110

4 by 0100

$(B64)_{16} \longrightarrow (101101100100)_2$ Ans.

(b) $(2C.9F)_{16} \longrightarrow (\;)_2$

Replace

2 by 0010

C by 1100

9 by 1001

F by 1111

$(2C.9F)_{16} \longrightarrow (00101100.10011111)_2$ Ans.

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7.] Octal to hexadecimal

7.1.] Direct method.

(1) $(63)_8 \longrightarrow (\ )_{16}$

Solve: $6 \times 8^1 + 3 \times 8^0$

$48 + 3$

51

$(63)_8 \longrightarrow (51)_{10}$

16	51	3
16	3	3
	0	

$(51)_{10} \longrightarrow (33)_{16}$

(5) $(821)_8 \longrightarrow (\ )_{16}$

Sol: Information is wrong!

7.2) Short cut method to convert given ... to it's equivelent Hexadecimal ©

number. first we replace each digit of given octal number to its equivelent three bit Binary number than we make a group of four bit and replace each group to it's equivelent hexadecimal number.

(a) $(672)_8 \longrightarrow ( )_{16}$

Soln ⇒ Replac

6 by 110

7 by 111

2 by 010

000110111010

$\longleftarrow \longleftarrow \longleftarrow$

Replace

0001 by 1

1011 by B

1010 by A

$(672)_8 \longrightarrow (1BA)_{16}$ Ans

(b) $(1632)_8 \longrightarrow ( )_{16}$

Sol ⇒ Replac

1 by 001

6 by 110

3 by 011

2 by 010

001110011010

$\longleftarrow \longleftarrow \longleftarrow$

Replace

0011 by 3

1001 by 9

1010 by A

$(1632)_8 \longrightarrow (39A)_{16}$ Ans

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(c) $(101.11)_8 \longrightarrow (\ )_{16}$

Replace

1 by 001

0 by 000

1 by 001

1 by 001

1 by 001

$(101.11)_8 \longrightarrow (001000001.0010)_{10}$

Replace

0000 by 0
0100 by 4
0001 by 1
0010 by 2

$(001000001.0010)_{10} \longrightarrow (041.2)_{16}$ Ans

8.1 Hexadecimal to octal

8.1] Direct method

(a) $(C6)_{16} \rightarrow (\ )_8$

$C \times 16^1 + 6 \times 16^0$

$12 \times 16 + 6 \times 1$

$192 + 6$

198

$(C6)_{16} \longrightarrow (198)_{10}$

8	198	6	↑
8	24	0	
8	3	3	
	0		

$(198)_{10} \longrightarrow (306)_8$ Ans

(b) $(36.F)_{16} \longrightarrow (\ )_8$

$3 \times 16^1 + 6 \times 16^0$ $\Rightarrow .15 \times 16^{-1}$

$48 + 6$ $\Rightarrow 15 \times \frac{1}{16} = 0.93$

54

$(36.F)_{16} \longrightarrow (54.93)_{10}$

8	54	$\cancel{6}$
8	$\cancel{6}$	$\cancel{6}$
	6	

$.93 \times 8 = 7.44 \rightarrow 7$ MSD

$.44 \times 8 = 3.52 \rightarrow 3$ LSD

$(54.93)_{10} \longrightarrow (66.73)_8$

8.2] Shortcu

octal nu

given oc

Binary

bit and

~~hexadecim~~ octal

(a) (4EF)

repla

4

E

F

(4E

(4EF)

(4EF

8.2) Shortcut method :- to convert given hexadecimal number to it's equivalent octal number. first we replace each digit of given octal number to its equivalent four bit Binary number then we make a group of three bit and replace each group to its equivalent ~~hexadecimal~~ octal number.

(a) $(4EF)_{16} \longrightarrow (\ )_8$

replace

4 by 0100

E by 1110

F by 1111

$(4EF)$ 0100 1110 1111

$(4EF)_{16} \rightarrow (2357)_8$

Replace

010 by 2

011 by 3

101 by 5

111 by 7

$(4EF)_{16} \longrightarrow (2357)_8$

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b) Any base to any base

a) $(37)_{10} \longrightarrow (\ )_4$

4	37	1	LSD
4	9	1	
4	2	2	MSD
	0		

$(37)_{10} \rightarrow (211)_4$

b) $(26)_7 \longrightarrow (\ )_8$

$2\times7^1 + 6\times7^0$

$14 + 6$

20

$(26)_7 \longrightarrow (20)_{10}$

$(20)_{10} \rightarrow (24)_8$

8	20	4
8	2	2
	0	

c) $(321)_5 \longrightarrow (\ )_9$

Sol: $3\times5^2 + 2\times5^1 + 1\times5^0$

$75 + 10 + 1$

(86)

$(321)_5 \longrightarrow (86)_{10}$

9	86	5	9	86	1
9	9	0	9	9	2
9	1	1	5	3	3
	0			0	

LSD

MSD

$(86)_{10} \rightarrow (501)_5$ Ans

Binary arithmetic

1.) Addition
2.) Subtraction
3.) multiplication
4.) Division
5.) Subtraction
6.)

1.) Addition +

ⓐ
ⓑ
ⓒ
ⓓ
ⓔ

example ⓑ

ⓒ

$$\begin{array}{r} 1110 \\ +\ 1010 \\ \hline 1100 \end{array}$$

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Binary arthmatic

1.) Addition
2.) Subtraction
3.) multipliction
4.) Division
5.) Subtraction using 2's compliment
6.)

1.) Addition :- Rule's for Addition

(a) 0+0=0
(b) 0+1=1
(c) 1+0=1
(d) 1+1 = 0 sum & 1 carry
(e) 1+1+1 = 1 sum & 1 carry

example :- (a)

```
   1011
 + 1101
  11000
```

(b)

```
   111010
 + 101110
  1101000
```

(c)

```
   1110111
 + 1010101
  11001100
```

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2.) Subtraction :- Rules of Subtraction

i.) 0 − 0 = 0
ii.) 1 − 0 = 1
iii.) 1 − 1 = 0
iv.) 0 − 1 = 1 difference & 1 Barrow

Example :- (a)

$$\begin{array}{r} 1101 \\ -1010 \\ \hline 0011 \end{array}$$

(b)

$$\begin{array}{r} 110001 \\ -10101 0 \\ \hline 000111 \end{array}$$

(c)

$$\begin{array}{r} 1100101 \\ -1011010 \\ \hline 0001011 \end{array}$$

(d)

$$\begin{array}{rl} 11010 & \rightarrow 1^{st} \\ -11101 & \rightarrow 2^{nd} \\ \hline 1101 & \end{array}$$

~~here no Barrow is not available It means second number is greater than first number to often the difference we subtract first number from second number and put negative sign before defference.~~

(a)

$$\begin{array}{rl} 11101 & \rightarrow 2^{nd} \\ -11010 & \rightarrow 1^{st} \\ \hline -00011 & \text{Ans} \end{array}$$

(b)

$$\begin{array}{r} 11010110 \\ -1110 1010 \\ \hline \times \end{array}$$

$$\begin{array}{r} 11101010 \\ -11010110 \\ \hline -00010100 \end{array}$$

(c)

$$\begin{array}{r} 110010010 \\ -10110110 1 \\ \hline 000100101 \end{array}$$

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3.) Multiplication :-

(a) 101 × 10

```
   101
  ×10
  ----
   000
 +101×
  ----
  1010
```

(b) 11010 × 110

Sol→

```
     11010
     ×110
    ------
     00000
    11010×
 + 11010××
 ---------
  10011100
```

4.) Division (Add & Sift method) :-

(c) 000111 (7)

(a) 110) 101010 (42)

```
      000111
110 ) 101010
     -0↓
      10
     -0↓
      101
     -0↓
      1010
     -110↓
       1001
      -110↓
        0110
       -110
        xxx
```

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5] Subtraction using 2's compliment

(a) 1's compliment :- ex. 1010 का 1's compliment = 0101

2's compliment :- 1's compliment + 1

ex. 1110 का 2's compliment = 1110 का 1's compliment + 1
= 0001 + 1 = 0010

2's compliment निकालने की सीधी विधि :-
दी गई बाइनरी संख्या के सीधे हाथ की तरफ से शुरू करो। सारे शून्य व प्रथम 1 को वैसे ही उतार लो। इसके पश्चात सभी बिटो को उल्टा कर दो। जैसे माना कि 1110 का 2's कॉम्प्लीमेंट निकालना है।

2's complement (b) 1110 → 0010 (Invert)

1010 → 2's complement ⇒ 0110
10000 → 2's complement ⇒ 10000

2's compliment subtraction method (un-signed Binary)
इस विधी मे जिस संख्या को घटाना है उसका 2's कॉम्प्लीमेंट ले लेते और घटाने की बजाए जोड़ते है। इस विधी को इस प्रकार समझा जा सकता है।

1. जिस संख्या को घटाना है उसका 2's compliment लो तथा (−) के स्थान पर (+) लिख दो। जोड़ो।
2. यदि अंत मे हासिल आता है तो उसे छोड़ दो तथा (+) का चिन्ह लगाओ।
3. यदि हासिल नही आता है तो एक बार फिर से योग का 2's कॉम्प्लीमेंट लो तथा (−) का चिन्ह लगाओ।

ex. (1) 1101 − 1010

(−) वाली संख्या 1010 का 2's कॉम्प्लीमेंट लेकर जोड़ने पर

$$\begin{array}{r} 1101 \\ +\,0110 \\ \hline 0011 \end{array}$$ हासिल (1)

चुकि अंत मे हासिल आया है अतः परिणाम धनात्मक है और हासिल को छोड़ने पर प्राप्त होगा अतः

1101 − 1010 = + 0011

1001 + 0010 ...
चुकि अंत मे को...
योग का 2...
क्रिया ...

$$\begin{array}{r} 0100 \\ +1 \\ \hline -0101 \end{array}$$

2) 1001 − 1110

(−) वाली संख्या 1110 का 2's compliment लेकर (−) की जगह (+) करने पर

1001 + 0010 = 1011

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चुकि अंत मे कोई हासिल नही आया। अतः परिणाम ऋणात्मक है।

योग का 2's compliment लेकर वास्तविक परिणाम प्राप्त किया जा सकता है। अतः

0100
+1
−0101

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Imp.

Logic gates

logic gates:- It's a basic unit of digital computer which perform all the arthematic and logical operation. there are Various type of logic gate. which are given below.

i.) Basic logic gate
ii.) Universal gate.
iii.) exclusive gate.
iv.) Tri state gate.

i.) Basic logic gate:- There are three types of basic logic gate which are given below

(A) AND gate
(B) OR gate
(C) NOT gate

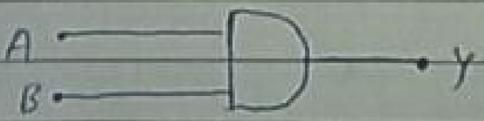
A.) AND gate:- AG.

A.1) two input AND gate:- It's a basic logic gate which take two input and gives only one output. If any one input is low voltage ~~input~~ (0). thise gate gives 0. otherwise it gives high Voltage. (1).

Boolean equation

$$Y = A \cdot B$$

Symbol:-



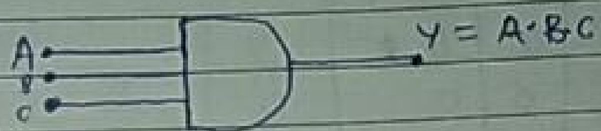
Truth Table:-

Truth Table :-

A	B	Y = A·B
0	0	0
0	1	0
1	0	0
1	1	1

A.2. Three input ~~AND~~ gate :- It's a basic logic gate. which take ~~three~~ input and ~~gives~~ any one output if any one ~~output~~ input is low voltage (0). this gate gives 0. otherwise it gives high voltage.

Symbol :-



Boolean equation :- $Y = A \cdot B \cdot C$.

Truth table :-

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

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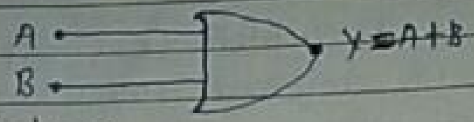
(B) OR gate :-

B.1.] Two Input OR gate :- It's a basic logic gate which takes two input and gives only one output if anyone input is high voltage this gate gives high voltage otherwise it gives low voltage.

Symbol :-



Booleoan Eqavation :-

$$Y = A + B$$

Truth table :-

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

B.2] Three input OR gate :- It's a basic logic gate which takes three input and gives only one output if anyone input is high voltage this gate gives high voltage ~~is high voltage this gate gives high voltage.~~ otherwise it gives low voltage

Symbol :-

Booleane quation

$$Y = A + B + C$$

~~Truth Table :-~~

Truth Table

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

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(c) NOT gate:- It's a basic logic gate which takes only one input and given only one output ~~only two input Not gate~~ which is compliment of input ~~Symbol~~ It's also knows as inverter.

Symbol:-

Boolean equation:-

$Y = \bar{A}$

Truth Table

A	Y
0	1
1	0

ii) Universal gate:- There are two types of universal gat

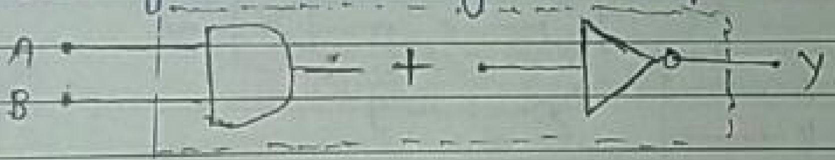
(A) NAND

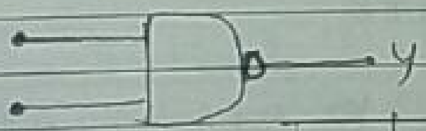
(B) NOR

(A) NAND:-

A.1) Two input NAND gate:- It's a universal gate it is made up one ~~do~~ AND and one NOT gate which gives compliment of AND gate.

Symbol:-





Boolean equation:-

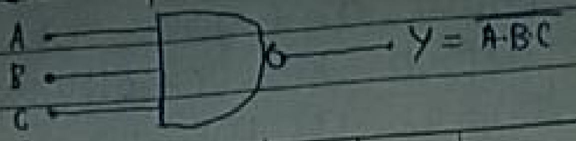
$Y = \overline{AB}$

~~Bool~~ Truth Table:-

A	B	A·B	$Y = \overline{AB}$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

A.2.] Three input NAND gate :-

Symbol :-



Boolean equation :-

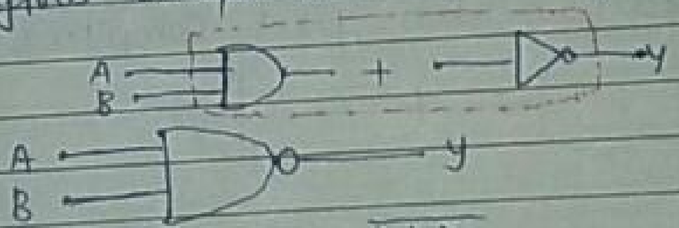
$Y = \overline{ABC}$

Truth Table :-

A	B	C	A·B·C	$Y = \overline{A \cdot B \cdot C}$
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	0	1
1	1	0	0	1
1	1	1	1	0

(c) NOR gate :- It's a universal gate. It is made up one OR gate and one NOT gate which gives compliment of OR gate.

Symbol :-



Boolean equation :- $Y = \overline{A+B}$

Truth Table :-

A	B	A+B	$Y = \overline{A+B}$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

c.1) Three input NOR gate :-

Boolean equation :-

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

Truth Table :-

A	B	C	$A+B+C$	$Y = \overline{A+B+C}$
0	0	0	0	1
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

iii.) Exclusive gate :- There are two types of exclusive gate.

(A) XOR gate (B) X-NOR gate

(A) XOR gate :-

A.1.) two input XOR gate :- It is an exclusive gate which take two input and gives only one ~~two~~ output. If no. of ~~of~~ high Voltage in input are in even number, then this gate give 0 otherwise it gives one. it is also used for binary addition

Symbol :-

Boolean equation

$$y = A \oplus B$$

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

A\B	0	1
0	0	1
1	1	0

wing

kmge

XOR Gate Truth Table :-

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

A.2] three input XOR gate :-

(1) Symbol :-

Boolean equation

$y = A \oplus B \oplus C$

using KM

A \ BC	00	01	11	10
0	0	1	0	1
1	1	0	1	0

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

Truth table :-

A	B	C	Y
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

B.] XNOR gate :-

B.1] two input XNOR gate :- It's an exclusive gate which takes two input and gives only one output. If no. of high voltage in input are in even number than this gate give 1. otherwise it gives 0.

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Symbol :-

Truth table :-

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

Boolean equation

$Y = A \odot B$

using kmap

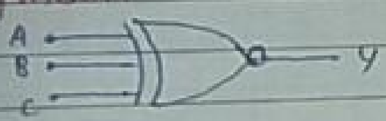
~~y =~~

A \ B	0	1
0	1	0
1	0	1

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

B.3) three input XNOR gate :-

Symbol :-



Truth table :-

A	B	C	Y
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

Boolean equation

$Y = A \odot B \odot C$

Using kmap

~~y =~~

A \ BC	00	01	11	10
0	1	0	1	0
1	0	1	0	1

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

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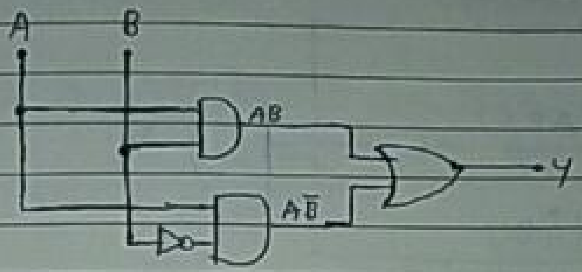
Design a logic circuit and Truth Table for given Boolean equation.

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

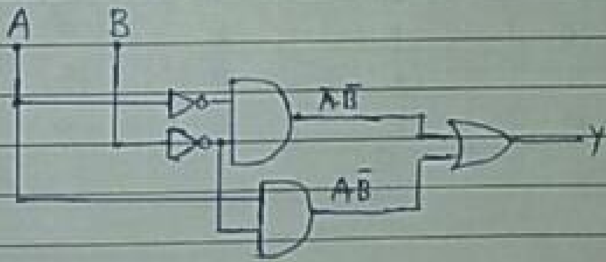


Truth Table

A	B	$\bar{B}$	$A \cdot B$	$A \cdot \bar{B}$	Y
0	0	1	0	0	0
0	1	0	0	0	0
1	0	1	0	1	1
1	1	0	1	0	1

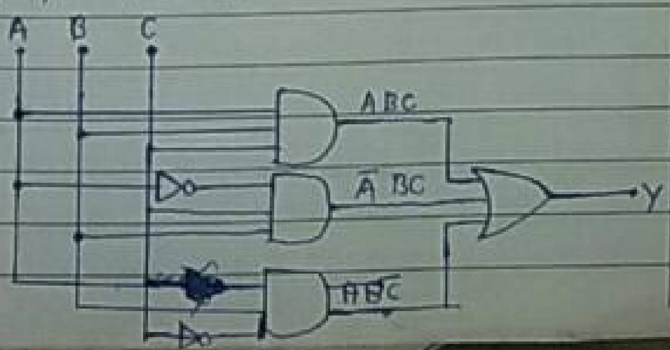
II $Y = ABC + \bar{A}BC + AB\bar{C}$

II. $\bar{A}\bar{B} + \bar{A}B$



A	B	$\bar{A}$	$\bar{B}$	$\bar{A} \cdot \bar{B}$	$A \cdot \bar{B}$
0	0	1	1	1	0
0	1	1	0	0	0
1	0	0	1	0	1
1	1	0	0	0	0

III $Y = ABC + \bar{A}BC + AB\bar{C}$ ~~ABC~~



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

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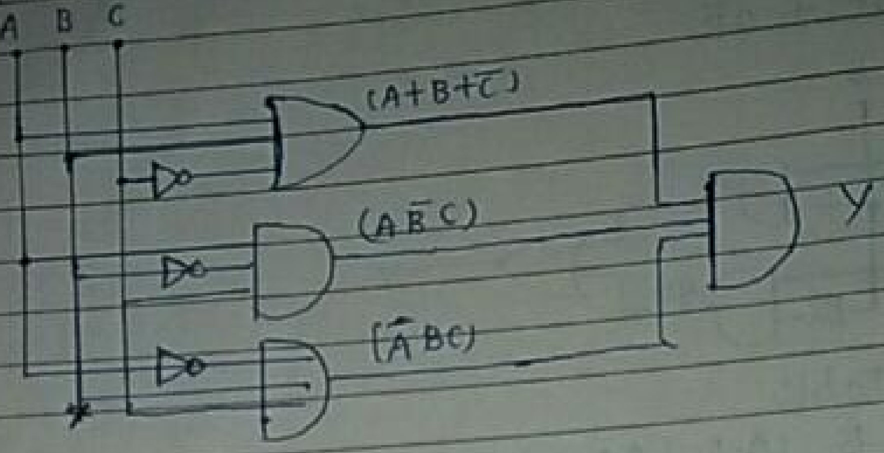
④ $Y = (A + B + \bar{C}) \cdot (A\bar{B}C) \cdot (\bar{A}BC)$

Solve:



Truth Table

A	B	C	$\bar{A}$	$\bar{B}$	$\bar{C}$	$A+B+\bar{C}$	$A\bar{B}C$	$\bar{A}BC$	Y
0	0	0	1	1	1	1	0	0	0
0	0	1	1	1	0	0	0	0	0
0	1	0	1	0	1	1	0	0	0
0	1	1	1	0	0	1	0	1	0
1	0	0	0	1	1	1	0	0	0
1	0	1	0	1	0	1	1	0	0
1	1	0	0	0	1	1	0	0	0
1	1	1	0	0	0	1	0	0	0

1.) Boolean Veriable :- A veriable which have only two Values 0/1. This type of veriable is known as Boolean veriable.

2.) Booleen Alzebra :- An Alzebra in which we deal with booleen veriable is known as Boolean Alzebra.

3.) Booleen eqvation :- when we use booleen veriable in any eqvation then eqvation is known as Boolean eqvation.

There are two types of booleen eqvation

i.) Sop (Sum of product) ii.) POS (product of Sum)

i.) SOP (Sum of product) :- in Sop from there are multiple product (term) and each term is known as fundamental product. and Value of each fundamental product is with respect to 1.

for example :- $y = A\bar{B} + AB$

Here two fundamental product which are ① $A\bar{B}$ ② AB.

In fundamental product If veriable a is given it means 1 and variable it means 0.

A BC	Y
0	0
0	0
0	0
	0
1	0
0	0
0	0
0	0
0	0

Find out all the fundamental product for two Vari.

A	B	fundamental product
0	0	$\bar{A}\bar{B}$
0	1	$\bar{A}B$
1	0	$A\bar{B}$
1	1	AB

ii.] ~~Sop~~ pos form. In pos form there are multiple sum (turm) and is turm is known as fundamental ~~and~~ sum and value at each fundamental ~~sum~~ sum is with respect to zero.

for example:- $y = (A+B) \cdot (A+\bar{B})$

Here there are two fundamental sum

① $A+B$ ② $A+\bar{B}$

In pos form ~~value~~ ~~of~~ Variable is given It means 0 and if $\overline{\text{Variable}}$ is given It means 1.

Find out all the fundamental sum for two Variable

A	B	fundamental turm
0	0	$A+B$
0	1	$A+\bar{B}$
1	0	$\bar{A}+B$
1	1	$\bar{A}+\bar{B}$

find out fundamental ~~ter~~ sum and fundamental product for Truth Table.

A	B	C	Y	fundamental
0	0	0	1	$\bar{A}\bar{B}\bar{C}$
0	0	1	1	$\bar{A}\bar{B}C$
0	1	0	0	$A+\bar{B}+C$
0	1	1	0	$A+\bar{B}+\bar{C}$
1	0	0	1	$A\bar{B}\bar{C}$
1	0	1	0	$\bar{A}+B+\bar{C}$
1	1	0	0	$\bar{A}+\bar{B}+C$
1	1	1	1	ABC

Min term and Max term

Minterm / Maxterm

1.) Minterm :- in ~~boolean~~ boolean Alzebra each fundamental product of sop form are also known as Minterm and represent by m. there for we represent Boolean eqvation sop form of given format.

$$\Sigma m = (m_1 + m_2 + m_3 + \cdots m_n)$$

2.) Maxterm :- in boolean Alzebra each fundamental sum of pos form are also known as maxterm which is represent by M. there for we represent Boolean eqvation pos form of given format.

$$\Pi M = (M_1 + M_2 + M_3 + \cdots M_n)$$

Exp: Simplification of ~~given~~ Boolean ~~expression~~ eqvation :- we

we can simplify any Boolean eqvation by two types

i.) Boolean using Boolean

ii.) using k-map

k-map :- It is a graphical ~~two~~ method to simplify any boolean eqvation.

1.) Kmap for two variable :-

A \ B	0	1
0	00	01
1	10	11

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i.) kmap for three variable :-

A \ BC	00	01	11	10
0	000	001	011	010
1	100	101	111	110

AB \ C	0	1
00	000	001
01	010	011
11	110	111
10	100	101

ii.) kmap for four variable :-

AB \ CD	00	01	11	10
00	0000	0001	0011	0010
01	0100	0101	0111	0110
11	1100	1101	1111	1110
10	1000	1001	1011	1010

iii.) Method for kmap :-

(a) Draw kmap :-
(b) put 1/0 on kmap using given boolean eqvation or truth table
(c) Make group ~~of~~ 0/1
(d) simplify it in sop or pos form

grouping

which a...

i.) single :-
(1)

ii.) pair :-

iii.) quad

iv.) Octa...

v.) overlap...

vi.) Rolling

grouping ⊢ collection of 0 or 1 is known as grouping there are various types of grouping which are-

i) single ⊢ It is only 1 or 0 on kmap.
1

ii) pair ⊢ collection of two 1/0 on kmap.

11

1
1

iii) quad ⊢ collection of four 1/0 on kmap.

1 1 1 1

1
1
1
1

1 1
1 1

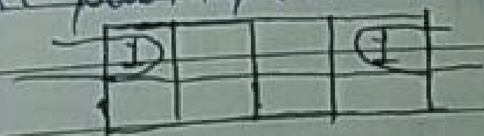
iv) octad ⊢ collection of eight 1/0 on kmap.

1 1 1 1
1 1 1 1

1 1
1 1
1 1
1 1

v) overlaping ⊢ We make pair / quad / octed by overlap
1 1 1 is known as overlaping.

vi) Rolling ⊢ we make pair / quad / octed using Rolling



① Simplify the given boolean equation in SOP form using kmap

i) $Y = \bar{A}\bar{B} + \bar{A}B$

A \ B	0	1
0	1	1
1		

$\boxed{Y = \bar{A}}$ Ans ⇒

ii.) $Y = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC + AB\bar{C}$

000 001 111 110

A \ BC	00	01	11	10
0	1	1		
1			1	1

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

iii.) $Y = \bar{A}B + A\bar{B} + AB$

01 10 11

A \ B	0	1
0		1
1	1	1

$Y = B + A$

iv] $Y = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}\,C + A\overline{B}\,\overline{C} + A\overline{B}C + \overline{A}B\overline{C}$

000   001   100   101   010

A \ BC	00	01	11	10
0	1	1		1
1	1	1		

$\cancel{Y = \overline{B} + A\overline{C}}$ Ans ⇒ $Y = \overline{B} + A\overline{C}$ Ans.

v] $Y = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}C + \overline{A}BC + \overline{A}B\overline{C} + A\overline{B}C + ABC + AB\overline{C}$

Sol ⇒   000   001   011   010   101   111   110

A \ BC	00	01	11	10
0	1	1	1	1
1		1	1	1

A \ BC	00	01	11	10
0	1	1	1	1
1		1	1	1

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

vi] $Y = \overline{A}\,\overline{B}\,\overline{C}\,\overline{D} + \overline{A}\,\overline{B}\,\overline{C}D + \overline{A}B\overline{C}\,\overline{D} + \overline{A}B\overline{C}D + A\overline{B}\,\overline{C}\,\overline{D}$

0000   0001   0100   0101   1000

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

$Y = \overline{A}\,\overline{C} + \overline{B}\,\overline{C}\,\overline{D}$

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vii.) $Y = \bar{A}B\bar{C}D + \bar{A}BCD + AB\bar{C}D + ABCD + \bar{A}BC\bar{D} + ABC\bar{D} + \ldots$

(0101, 0111, 1101, 1111, 0110, 1110)

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

$Y = AB + BD + BC$ Ans ⇒

viii.) $\Sigma m(ABCD) = \{0, 2, 4, 5, 6, 8, 10, 12, 14\}$

(0000, 0010, 0100, 0101, 0110, 1000, 1010, 1100, 1110)

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

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

xi.] $\Pi M(ABCD) = \{3, 7, 15\}$

0011 0111 1111

Ans⇒

AB \ CD	00	01	11	10
00	1	1	0	1
01	1	1	0	1
11	1	1	0	1
10	1	1	1	1

480

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

000 001 111

X.] $\Sigma M(ABC) = \{0, 1, 7\}$

Ans⇒ ~~information is wrong.~~

A \ BC	00	01	11	10
0	1	1		
1			1	

550

380

340

54
112
96
32

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

550 850

294 286 6.8

~~Simplify the boolean equation in pop~~ pos form (4)

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

A \ B	0	1
0	1	0
1	1	0

~~$Y = \bar{B}$ Ans~~

Ans ⇒ $Y = \bar{B}$

(5.)

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

A \ BC	00	01	11	10
0	0			0
1		~~0~~		0

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

(3) $\Pi M(ABC) = \{1, 3, 6, 7\}$

001, 011, 110, 111

A \ BC	00	01	11	10
0	ϕ	0	0	1
1	1	1	0	0

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

φ00 0φ0 φφ0 φφφ

④ $A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} + AB\bar{C} + ABC$

A \ BC	00	01	11	10
0	0	0	0	1
1	1	0	1	1

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

⑤ $\prod M(ABCD) = \{2, 4, 6, 10, 12, 13\}$

(0010, 0100, 0110, 1010, 1100, 1101)

AB \ CD	00	01	11	10
00				0
01	0			0
11	0	0		
10				0

AB \ CD	00	01	11	10
00				0
01	0			0
11	0	0		
10				0

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

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

Date: / / Page no:

Don't care condition in kmap ← ~~in~~ don't care condition are give than put cross or given term if grouping is possible with don't care than we consider otherwise we ignore it.

Don't care represented by d and given with max term and min term

Simplify the given boolean equation in sop form on kmap with don't care condition

(1) $y\ f(ABC) = \Sigma m(0, 4, 7) + d(1, 6)$

(2) $y\ f(ABC) = \pi M\{1, 3, 7\} \cdot d\{0, 6\}$

(3) $y\ f(ABCD) = \Sigma m\{0, 1, 3, 4\} + d\{3, 5, 7\}$

(1)

A \ BC	00	01	11	10
0	1	x		
1	1		1	x

$Y = \overline{B}\,\overline{C} + AB$

(2)

A \ BC	00	01	11	10
0	x	0	0	1
1	1	1	0	x

$Y = (\overline{A} + B) \cdot C$: Ans

(3)

AB
00
01
11
10

Q.

AB \ CD	00	01	11	10
00	1	1	X	1
01	1	X	X	
11	0	0		
10				

$$Y = \bar{A}\bar{B} + \bar{A}\bar{C}$$ Ans.

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Combinational & sequentional logic curcuit

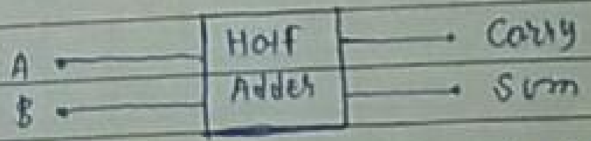
There are two types of logic curcuit
i.) Combinational ii.) Sequentional.

i.) Combinational :- A logic curcuit in which output depends upon only it's current input then this type of logic curcuit is known as combinational logic curcuit
for ex. :- half adder, full adder, half subtracter, full subtracter, multiplaction, antimultiplaction

ii.) Sequentional :- A logic curcuit in which output depends upon its current input as well as its previous input then this type of logic curcuit is known as sequentional logic curcuit
for ex :- register, counter, flipflop

Imp
1.) Half Adder & Full Adder
1.1 Half Adder :- It's a combinational logic curcuit which perform binary addition of 2 bit.

Block diagram

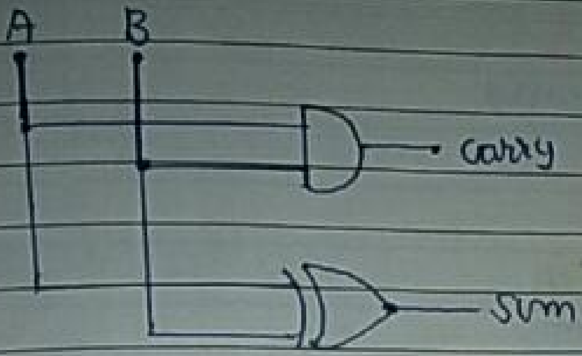


Truth Table :-

xor and and xor

A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Logic circuit ⊢



Boolean eqvation ⊢ $carry = A \cdot B$

$sum = A \oplus B$

या $sum = \bar{A}B + A\bar{B}$

1.2 | Full Adder ⊢ It's a combinational logic circuit which perform binary addition on 3 bits.

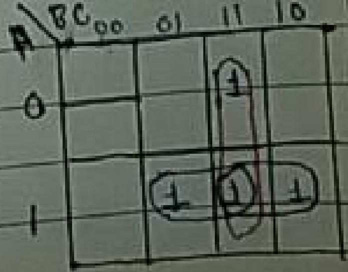
Block diagram ⊢

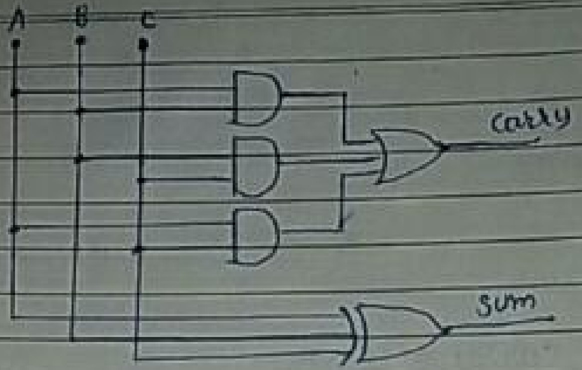
Truth Table ⊢

A	B	C	sum	carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Boolean eqvation ⊢ $sum = A \oplus B \oplus C$

$carry = AC + BC + AB$





2.) Half Subtracter & full Subtracter

2.1.) Half Subtracter :- It's a combinational logic curcuit which perform binary Subtraction on two bit.

Block diagram :-

Truth table :-

A	B	Sub. ~~Borrow~~	Borrow ~~Subtraction~~
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

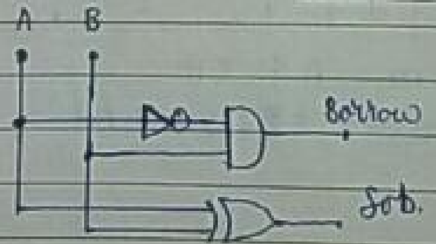
Boolean Equation :-

$Sub. = A \oplus B$

$Borrow = \bar{A}B$

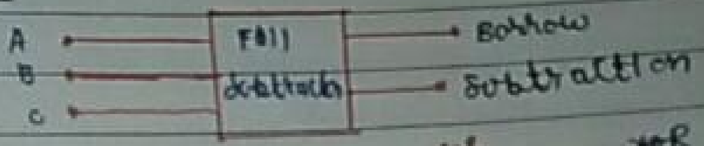
A \ B	0	1
0	0	1
1	0	0

logic curcuit :-



.1 Full Subtractor: It's a combination logic circuit which perform binary subtraction on 3 bit.

Block diagram:



Truth Table:

A	B	C	Borrow ~~Sum~~ Sub. (xor)	Borrow ~~Sub~~ Sub. (xoR)
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

A \ BC	00	01	11	10
0	0	1	1	1
1	0	0	1	0

• Boolean eqvation: $A \ominus B$

Sub. = ~~$\bar{A} \cdot C + BC + \bar{A}B$~~

Borrow = $\bar{A} \cdot C + BC + \bar{A}B$

Logic Circuit: