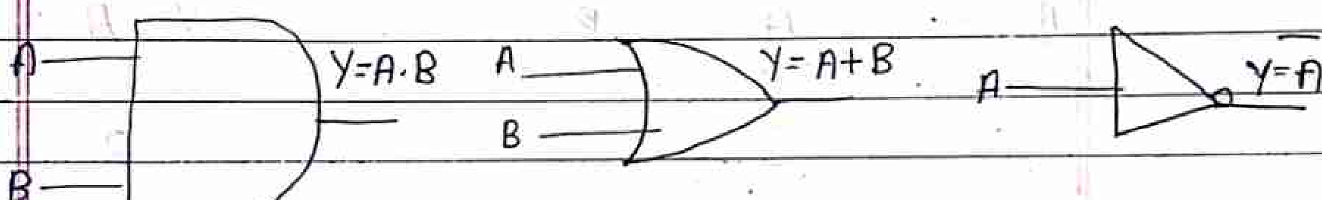
* Analog vs digital system:

~~Top1~~

- Gate : Gate is electronic circuit which is having one or more input and gives output according to some predifined logic

* Basic Gate.

i) AND   ii) OR   iii) NOT



multiplication   Addition

- Truth table : Truth table which contain input and their respective output

* Truth Table

" AND "

Inputs		output
A	B	Y = A.B
0	0	0
0	1	0
1	0	0
1	1	1

- Truth table 'OR'

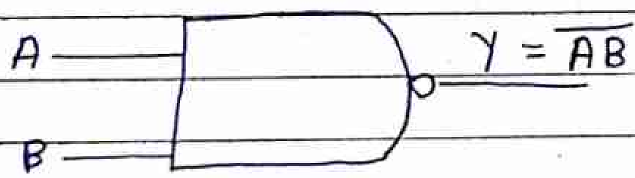
Input		output
A	B	$Y = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

- Truth table 'NOT'

Input	output
A	$Y = \overline{A}$
0	1
1	0

* Universal Gate

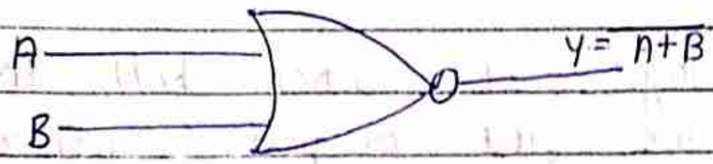
1) NAND (SOP)



- Truth table

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

2) NOR.



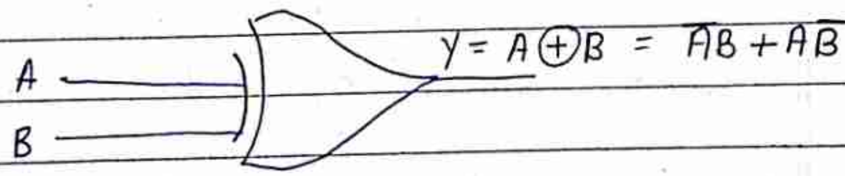
• Truth table

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

* Special Gates

1) Ex OR

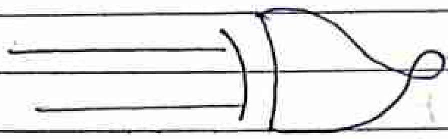
A electric circuit if both the input and ~~is same~~ is same then output will be zero otherwise it's one



Inputs		output
A	B	$\bar{A}B + A\bar{B}$
0	0	0
0	1	1
1	0	1
1	1	0

2) Ex NOR

A logic ckt when both inputs are same we get output 1, otherwise it is zero.



$Y = A \odot B = AB + \overline{AB}$

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

* Number System :

① Decimal – Symbols – 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 – Base = 10

Binary – symbol – 0, 1 – Base = 2

Octal – symbol – 0, 1, 2, 3, 4, 5, 6, 7 – Base = 8

Hexadecimal – symbol – 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F Base = 16

* Number system :

It is an order set of symbol known as digit with rules define for performing arithamatic operations like addition, multiplication etc.

- Example of number system are :

1) Binary   3) decimal
2) octal   4) hexadecimal

* Conversion of Number System

1) Decimal no to binary.

(1) $(25)_{10} = (?)_2$

	Q	R
$\frac{25}{2}$	12	1
$\frac{12}{2}$	6	0
$\frac{6}{2}$	3	0
$\frac{3}{2}$	1	1
$\frac{1}{2}$	0	1

$$\boxed{(25)_{10} = (11001)_2}$$

(2) $(29)_{10} = (?)_2$

	Q.	R
$\frac{29}{2}$	14	1
$\frac{14}{2}$	7	0
$\frac{7}{2}$	3	1
$\frac{3}{2}$	1	1
$\frac{1}{2}$	0	1

$$\boxed{(29)_{10} = (11101)_2}$$

Radix

(3) $(29.25)_{10} = (?)_2$

⇒ here

29 = integer part .25 = fractional part

$\therefore 29 = (11101)_2$

$$\begin{array}{r} .25 \\ \times\ 2 \\ \hline 0.50 \end{array} \qquad \begin{array}{r} 0.50 \\ \times\ \ 0 \\ \hline 1.00 \end{array}$$

$\therefore (0.25) = 01$

$$\boxed{(29.25)_{10} = (11101.01)_2}$$

4) $(16.125)_{10} = (?)_2$

$\Rightarrow$

	Q	R
$\frac{16}{2}$	8	0
$\frac{8}{2}$	4	0
$\frac{4}{2}$	2	0
$\frac{2}{2}$	1	0
$\frac{1}{2}$	0	1

$\therefore (16)_{10} = (10000)_2$

$$\begin{array}{r} .125 \\ \times\ 2 \\ \hline 0.25 \end{array} \quad \begin{array}{r} 0.25 \\ \times\ 2 \\ \hline 0.5 \end{array} \quad \begin{array}{r} 0.5 \\ \times\ 2 \\ \hline 1.00 \end{array}$$

$$\boxed{\therefore (16.125)_{10} = (10000.001)}$$

* Decimal to octal

1) $(25)_{10} = (?)_8$

$(25)_D = (?)_O$

	Q	R
$\frac{25}{8}$	3	1
$\frac{3}{8}$	0	3

$\boxed{(25)_D = (31)_O}$

2) $(29)_{10} = (?)_8$

	Q	R
$\frac{29}{8}$	3	5
$\frac{3}{8}$	0	3

$\boxed{(29)_{10} = (35)_8}$

3) $(29.25)_{10} = (?)_8$

	Q	R
$\frac{29}{8}$	3	5
$\frac{3}{8}$	0	3

$\therefore (29)_{10} = (35)_8$

$$\begin{array}{r} .25 \\ \times 8 \\ \hline 2.000 \end{array} \qquad \begin{array}{r} 0.000 \\ 8 \\ \hline 0000 \end{array}$$

$$\boxed{(29.25)_{10} = (35.20)_8}$$

4) $(16.125)_{10} = (?)_8$

	Q	R
$\frac{16}{8}$	2	0
$\frac{2}{8}$	0	2

$(16)_0 = (20)_0$

$$\begin{array}{r} .125 \\ \times 8 \\ \hline 1 \end{array}$$

$$\boxed{(16.125)_D = (20.1)_0}$$

* Decimal to hexadecimal

1) $(25)_{10} = (?)_{16}$

	Q	R
$\frac{25}{16}$	1	9
$\frac{1}{16}$	0	1

$$\boxed{(25)_{10} = (19)_{16}}$$

2) $(29)_{10} = (?)_{16}$

$(29)_D = (?)_H$

	Q	R
$\frac{29}{16}$	1	13
$\frac{1}{16}$	0	1

$$\boxed{(29)_{10} = (1D)_{16}}$$

3) $(29.25)_D = (?)_H$

	Q	R
$\frac{29}{16}$	1	13
$\frac{1}{16}$	0	1

$$(29)_{10} = (1D)_{16}$$

$$\begin{array}{r} .25 \\ \times 16 \\ \hline 4.00 \end{array} \qquad \begin{array}{r} 0.000 \\ \times 16 \\ \hline 0.000 \end{array}$$

$$\boxed{(29.25)_{10} = (1D.40)_{16}}$$

4) $(16.125)_d = (?)_h$

	Q	R
$\frac{16}{16}$	1	0
$\frac{1}{16}$	0	1

$$(16)_d = (10)_h$$

$$\begin{array}{r} .125 \\ \times 16 \\ \hline 2.000 \end{array} \qquad \begin{array}{r} 0.000 \\ \times 16 \\ \hline 0.000 \end{array}$$

$$\boxed{(16.125)d = (10.20)h}$$

5) $(121.428)d = (?)h$

	Q	R
$\frac{121}{16}$	7	9
$\frac{7}{16}$	0	7

$$\begin{array}{r} 0.428 \\ \times 16 \\ \hline 6.848 \end{array} \rightarrow \begin{array}{r} 0.848 \\ \times 16 \\ \hline 13.568 \end{array} \rightarrow \begin{array}{r} 0.568 \\ \times 16 \\ \hline 9.088 \end{array}$$

$$\boxed{(121.428)d = (79.6D9)h}$$

* Binary to Decimal

(1) $(11001)_b = (?)_d$

$$\begin{array}{ccccc} 4 & 3 & 2 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \end{array}$$

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

$= 16 + 8 + 1$

$\boxed{(11001)_b = (25)_d}$

2) $(11101)_b = (?)_d$

$$\begin{array}{ccccc} 4 & 3 & 2 & 1 & 0 \\ 1 & 1 & 1 & 0 & 1 \end{array}$$

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

$= 16 + 8 + 4 + 1$

$\boxed{(11101)_b = (29)_d}$

3) $(11101.01)_2 = (?)_{10}$

$(11101)_b = (29)_d$

$$\begin{array}{cccccccc} 4 & 3 & 2 & 1 & 0 & & -1 & -2 \\ 1 & 1 & 1 & 0 & 1 & . & 0 & 1 \end{array}$$

$(11101.01) = 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 0 \times 2^{-1} + 1 \times 2^{-2}$

$= 16 + 8 + 4 + 1 + 1/4$

$\boxed{(11101.01)_2 = (29.25)_{10}}$

(4) $(10000.001)_b = (?)_d$

$$\overset{4}{1}\ \overset{3}{0}\ \overset{2}{0}\ \overset{1}{0}\ \overset{0}{0}\ .\ \overset{-1}{0}\ \overset{-2}{0}\ \overset{-3}{1}$$

$$(10000.001)_b = 1\times2^4 + 0\times2^3 + 0\times2^2 + 0\times2^1 + 0\times2^0 + 0\times2^{-1} + 0\times2^{-2} + 1\times2^{-3}$$

$$= 16 + 0 + 0 + 0 + 0 + 0 + 1/8$$

$$\boxed{(10000.001)_b = (16.125)_d}$$

* Binary to ~~Decimal~~ Octal

(1) $(11001)_b = (?)_d$

$$\underbrace{11}_{3}\ \underbrace{001}_{1}$$

$\therefore (11001)_2 = (31)_8$.

A	B	C	Decimal
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

(2) $(11101)_2 = (?)_8$

$$\underbrace{11}_{3}\ \underbrace{101}_{5}$$

$\therefore (11101)_2 = (35)_8$

3) $(011101.01)_2 = (?)_8$

$$\underbrace{011}_{3}\ \underbrace{101}_{5}\ .\ \underbrace{01}_{2}$$

$$\boxed{\therefore (011101.01)_2 = (35.2)_8}$$

4) $(10000.001)_2 = (?)_8$

$$\underbrace{10}_{2}\ \underbrace{000}_{0}\ .\ \underbrace{001}_{1}$$

$$\boxed{\therefore (10000.001)_2 = (20.1)_8}$$

* Binary to hexadecimal

1) $(011001)_2 = (?)_{16}$

$\underline{0001}\ \underline{1001}$
$\quad 1 \quad\quad 9.$

$\boxed{(011001)_b = (19)_h}$

2) $(11101)_2 = (?)_{16}$

$\underline{0001}\ \underline{1101}$
$\quad 1 \quad\quad D$

$\boxed{(11101)_2 = (1D)_{16}}$

3) $(11101.01)_2 = (?)$

$\underline{0001}\ \underline{1101}\ .\ \underline{0100}$
$\quad 1 \quad\quad D \quad\quad 4$

$\boxed{(11101.01)_2 = (1D.4)_{16}}$

(4) $(10000.001)_2 = (?)_{16}$

$\underline{1}\ \underline{0000}\ .\ \underline{0010}$

$\ 1 \quad\ 0 \quad . \quad 2$

$$\boxed{(10000.001)_2 = (10.2)_{16}}$$

* Codes

It used to information representation in binary format ~~whict~~ using binary (bits).

1) straight binary
2) Binary coded Decimal (BCD)
3) Excess - 3 or self complementry code.
4) Gray or Reflected code

* Various Binary codes.

Decimal	Binary	BCD	Excess-3	Gray
number	B_1 B_2 B_3 B_4	D C B A	E_1 E_2 E_3 E_4	G_3 G_2 G_1 G_0
0	0 0 0 0	0 0 0 0	0 0 1 1	0 0 0 0
1	0 0 0 1	0 0 0 1	0 1 0 0	0 0 0 1
2	0 0 1 0	0 0 1 0	0 1 0 1	0 0 1 1
3	0 0 1 1	0 0 1 1	0 1 1 0	0 0 1 0
4	0 1 0 0	0 1 0 0	0 1 1 1	0 1 1 0
5	0 1 0 1	0 1 0 1	1 0 0 0	0 1 1 1
6	0 1 1 0	0 1 1 0	1 0 0 1	0 1 0 1
7	0 1 1 1	0 1 1 1	1 0 1 0	0 1 0 0
8	1 0 0 0	1 0 0 0	1 0 1 1	1 1 0 0
9	1 0 0 1	1 0 0 1	1 1 0 0	1 1 0 1
10	1 0 1 0			1 1 1 1
11	1 0 1 1			1 1 1 0
12	1 1 0 0			1 0 1 0
13	1 1 0 1			1 0 1 1
14	1 1 1 0			1 0 0 1
15	1 1 1 1			1 0 0 0

* Excess-3 code

This is another of BCD code, in which each decimal digit coded into a 4-bit binary code the code for each digit is obtained by adding decimal 3 to natural BCD code of digit

* Gray code

It is a very useful code in which a decimal number is represented to binary form in such a way so that each number differ from preceding and succeeding number by a single bit.

Boolean Algebra

⇒ English mathematician George Bode.
⇒ manupulation of binary variables.

(1) $A + 0 = A$
(2) $A \cdot 1 = A$
(3) $A + 1 = 1$
(4) $A \cdot 0 = 0$
(5) $A + A = A$
(6) $A \cdot A = A$
(7) $A + \bar{A} = 1$
(8) $A \cdot \bar{A} = 0$
(9) $A \cdot (B + C) = AB + AC$
(10) $A + BC = (A+C)(A+B)$
(11) $A + AB = A(1 + B) = A$
(12) $A(A+B) = A$
13) $\cancel{A(\bar{A}+B)}$ * $A + \bar{A}B = (A+B)$
(14) $A(\bar{A} + B) = AB$
(15) $AB + A\bar{B} = A$
(16) $(A+B) \cdot (A+\bar{B}) = A$
(17) $AB + \bar{A}C = (A+C)(\bar{A}+B)$

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

19) $AB + \bar{A}C + BC = AB + \bar{A}C$

20) $\overline{A \cdot B \cdot C \cdots} = \bar{A} + \bar{B} + \bar{C} + \cdots$

21) $\overline{A+B+C+\cdots} = \bar{A} \cdot \bar{B} \cdot \bar{C} \cdots$

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

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

de morgans Theorem

* De morgan's Theorem

It states that the compliment of conjuctions is the dijunction of the compliment and vice versa

Imp

Que: State and prove De morgan's theorem

Ans: Def^n ⇒ It states that the compliment of conjuctions is the dijunction of the compliment and vice verse.

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

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

For the proof of this therom we are considering only two variables

∴ De morgan's theorem equation will be

$$\overline{A \cdot B} = \bar{A} + \bar{B} \quad \text{— (i)}$$

$$\overline{A+B} = \bar{A} \cdot \bar{B} \quad \text{— (ii)}$$

★ Truth Table for eq^n (i)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
A	B	$\bar{A}$	$\bar{B}$	$A \cdot B$	$\overline{A \cdot B}$	$\bar{A} + \bar{B}$
0	0	1	1	0	1	1
0	1	1	0	0	1	1
1	0	0	1	0	1	1
1	1	0	0	1	0	0

From colum no 6 & 7 it's found that $\overline{A \cdot B} = \bar{A} + \bar{B}$ hence proved.

★ Truth table for eq^n (ii)

1	2	3	4	5	6
A	B	$\bar{A}$	$\bar{B}$	$\overline{A+B}$	$\bar{A} \cdot \bar{B}$
0	0	1	1	1	1
0	1	1	0	0	0
1	0	0	1	0	0
1	1	0	0	0	0

From column no 5 & 6 it's found that $\overline{A+B} = \bar{A} \cdot \bar{B}$ hence proved.