Unit - 5

Digital Electronics

Logic gate :- A logic gate is a circuit design by Using electronics components like diaod, transistor, resister and node. As the same employs logic gate is design to perform logical operations in digital system like computer, communication system etc. It has more than input and output.

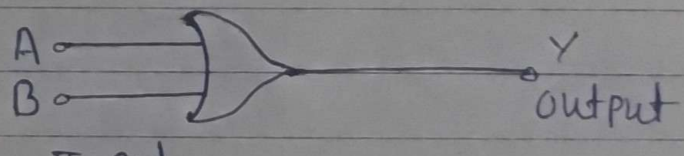
Classification into measure types of logic gates -

① Basic Logic gates -

(i) OR Gate (ii) AND Gate (iii) NOT Gate

(i) **OR Gate** :-

Symbol



formulla

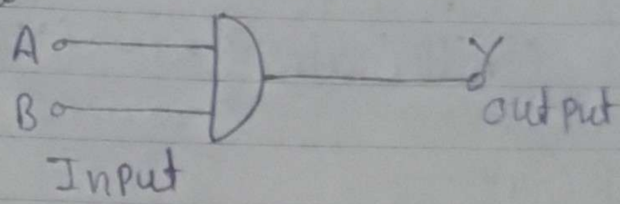
$$Y = A + B$$

Truth table

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

(ii) AND Gate –

Symbol



formula

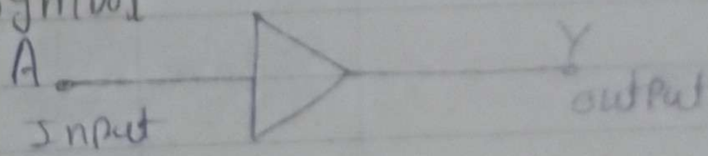
~~Y = A - B~~ $Y = A \cdot B$

Truth Table –

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

(iii) NOT Gate –

Symbol



formula

$Y = \bar{A}$ (Inverse/ of A)
opposite

Truth Table

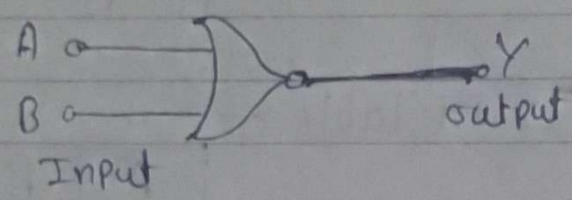
A	Y
0	1
1	0

② Universal Logic gates —

(i) NOR Gate — (NOT + OR) Gate
(ii) NAND Gate — (NOT + AND) Gate

(i) NOR Gate —

Symbol —



formula —

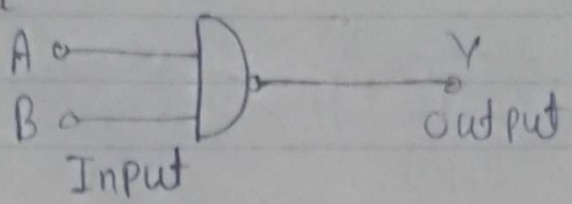
$$Y = \overline{A+B}$$

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

(ii) NAND Gate -

Symbol -



Formula -

$$Y = \overline{A \cdot B}$$

Truth Table -

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

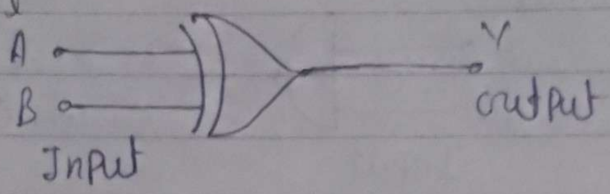
③ Derived Logic Gate

(i) X-OR Gate

(ii) X-NOR Gate

(i) X-OR Gate -

Symbol -



formula -

$$Y = A \oplus B$$

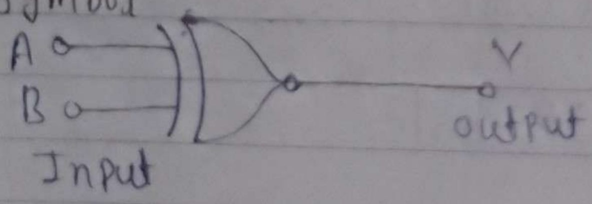
or $Y = \bar{A} \cdot B + A \cdot \bar{B}$

Truth Table -

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

(ii) X-NOR Gate -

Symbol -



formulla -

$$Y = A \odot B$$

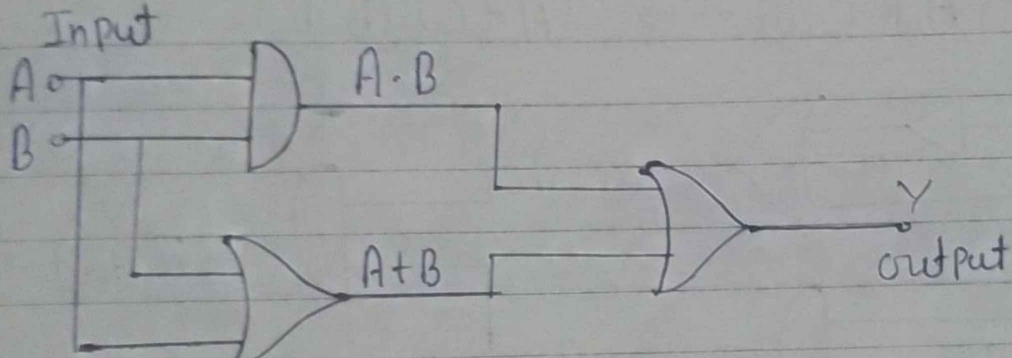
or $Y = \bar{A} \cdot \bar{B} + A \cdot B$

Truth Table -

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

ex-

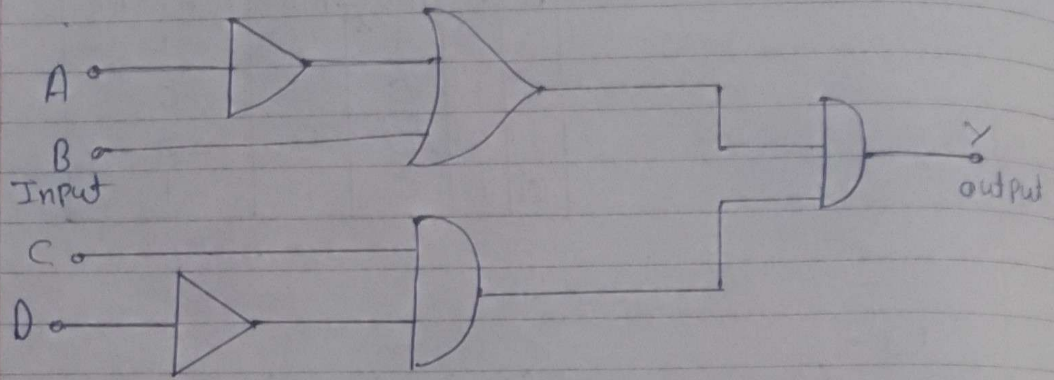
① $(A, B) \longrightarrow (A\cdot B) + (A+B)$



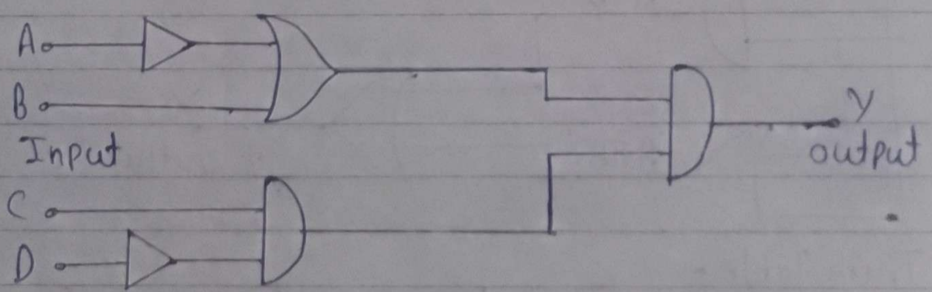
Truth Table -

A	B	$A\cdot B$	$A+B$	$(A\cdot B) + (A+B)$
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	1

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



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



Number System — Genarally in any number System their is an ordered set of Symbols called digits. which are used to specify any number the digits are defined for performing operations such as additions, Substractions, multiplications, division etc. A collection of these digits form a number which is general has two parts namily integer and fractional.

Types of number system

(i) Binary number system - (0,1).

Base - 2
numbers - 0,1

(ii) Octal number System

Base - 8
numbers - 0,1,2,3,4,5,6,7

(iii) Decimal number system

Base - 10
numbers - 0,1,2,3,4,5,6,7,8,9

(iv) Hexa Decimal number System

Base - 16
numbers - 0 to 15
where, 10 = A, 11 = B, 12 = C, 13 = D, 14 = E and 15 = F

Q: $(48.62)_{10} = (?)_2$

Solve

$$\begin{array}{ccc} 48 & . & 62 \\ \downarrow & & \downarrow \\ 48 & & 0.62 \end{array}$$

2	48	
2	24	0
2	12	0
2	6	0
2	3	10
2	1	1

$48 = 11000$

0.62×2

$1.24 = 1$

$0.24 \times 2 = 0$

$0.48 \times 2 = 0$

$0.96 \times 2 = 1$

$0.62 = 1001$

$(48.62)_{10} = (11000.1001)_2$

Q- $(1111.1011)_2$

$(1111.1011)_2 =$

$= 1\times2^3 + 1\times2^2 + 1\times2^1 + 1\times2^0 . 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3} + 1\times2^{-4}$

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

$= 15 . 0.5 + 0.125 + 0.0625$

$(1111.1011)_2 = (15.6875)_{10}$

De Morgans theorem –

(1) First theorem–

Complement of sum is equal to the product of complements

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

$$\text{OR } (A+B)' = A'\cdot B'$$

(2) Second theorem

Complement of product is equal to the sum of complement

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

$$\text{OR } (A\cdot B)' = A'+B'$$

Proof =>

Inputs		Outputs			
A	B	$(A+B)'$	$(A\cdot B)'$	$A'+B'$	$A'\cdot B'$
0	0	1	1	1	1
0	1	0	1	1	0
1	0	0	1	1	0
1	1	0	0	0	0

Introduction to Semi-conductors →

Semi-conductors are materials with electrical conductivity ~~will~~ between that conductors like metals & insulator (like cermic & glass). they are crucial in electronics. enabling the creation of devices like transistors ~~as~~ of Semi-conductors and integrated circuit The conductivity of semi conductors canbe controlled making them versetile for a wide range of applications.

key charastristic of it -

1 Intermideat conductivity — Semi-conductor have a ragistively or inverse conductivity between that of conductors and insulators typically in the range of ten ~~to~~o the power of ~~tour~~ four ohm(s) per c.m

Energy bend gap — They have a forbidon enargy bend gap between balanced bend (where electrons are ~~are~~ depandon atom) ~~or~~ and conduction bend (where electrons are free to move) -

tempreture dependance — The conductivity of semi-conductor is tempreture dependent incorcasing as tempreture rises

charge circuits - unlike conducters. Semi-conducters don't have a constant Abundands of charge careers (e-o) at all times they realy on external factors like tempreture or light to generate or madifiey these careers.

Types of Semi-conductors -

(i) Intensive Semi-conductors
(ii) extensive Semi-conductors

Application -

(i) transistor, Solarcells, LED, ICs etc