Binary Logic Gates :-

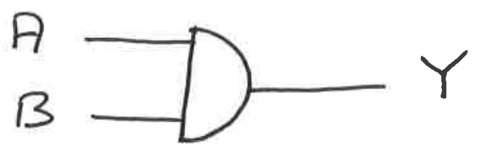
Electronic Logic gates are primary used in digital computer they are many factor mainly as IC the Tr, diode & any other solide state computerts.

The gates its have one input or many input but its have one output. The (American standerd A sociation) symbols are:-

1. AND Gate.
2. oR Gate.
3. Invertor Gate or (NOT Gate).
4. NAND Gate = Not AND
5. NoR Gate = Not oR

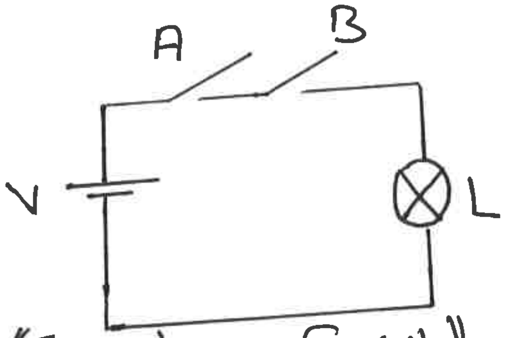
① AND Gate :-

symbole



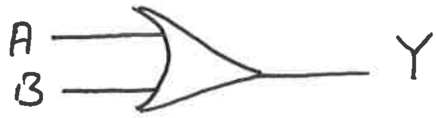
- AND : Logical multiplication
- No. of variable = 2
- No. of propanties $= 2^2 = 4$
- Function : $F = Y = A * B = A \cdot B = AB$
- Truth table

A (i/p)	B (i/p)	Y (o/p)
0	0	0
0	1	0
1	0	0
1	1	1

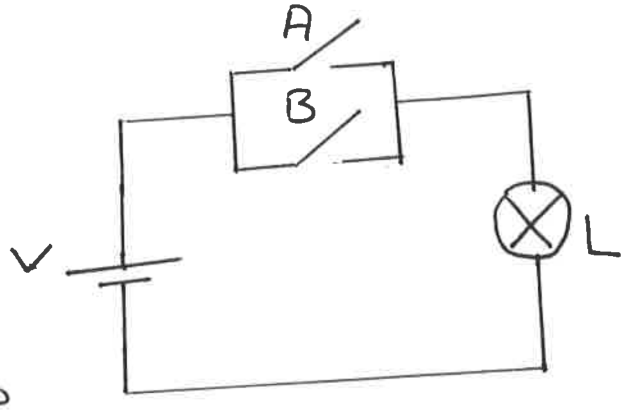


((Swiching Circuit))

② OR Gate:-

Symbole 

$Y = A + B$

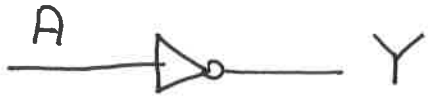


(Swiching Circuit)

- OR : Logical Addition.
- No. of Variable = 2
- No. of pro. $= 2^2 = 4$
- Function $Y = A + B$
- Truth table

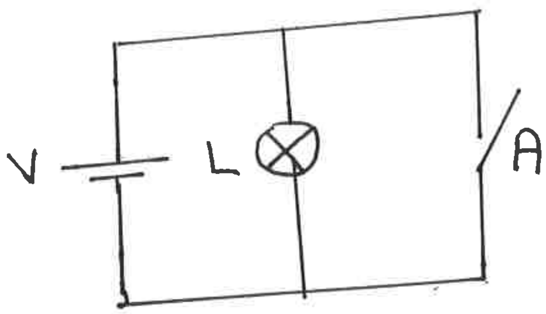
i/p A	B	Y o/p
0	0	0
0	1	1
1	0	1
1	1	1

③ NOT Gate

Symbole 

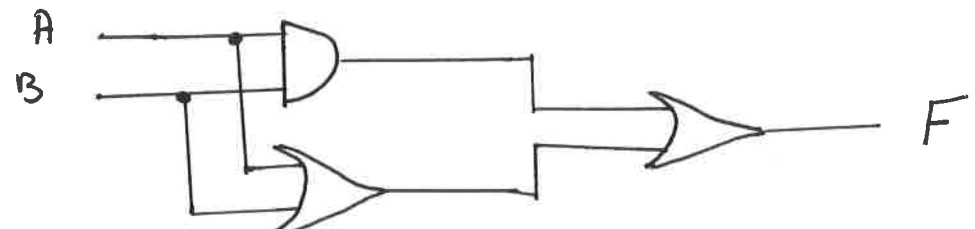
- Function $Y = \bar{A}$
- Truth table

i/p A	o/p Y
0	1
1	0



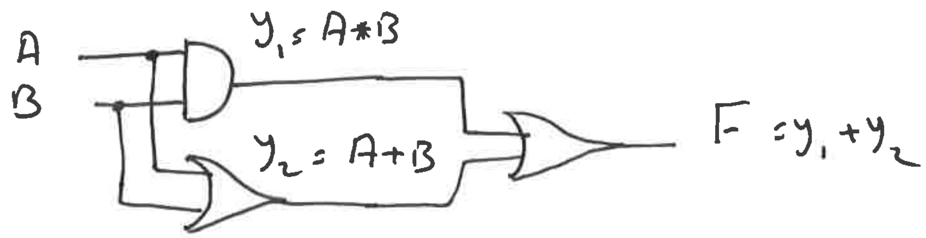
((Switching Circuit))

Ex



Find the truth table of F?

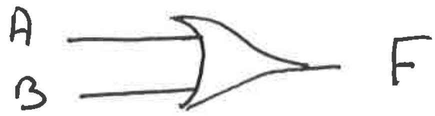
Sol^n: —



$$F = AB + A + B$$
$$= A(B+1) + B$$
$$= A*1 + B$$
$$= A + B$$

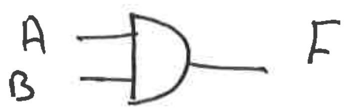
* Truth table

A	B	AB	A+B	F
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	1

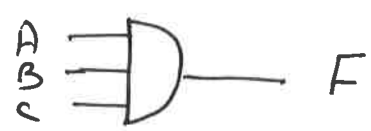


Ex Implement the following Function :-

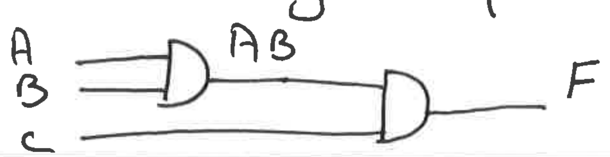
① $F = AB$



② $F = ABC$

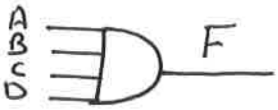


③ $F = ABC$ using 2-input AND gate only

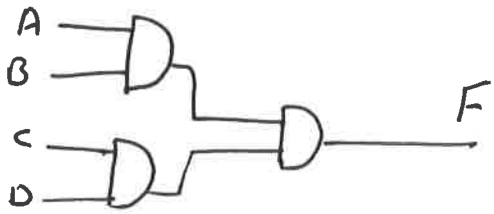


(4) $F = (AB)(CD)$

(a)

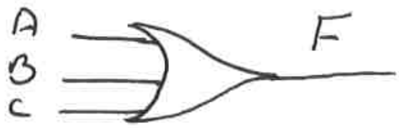


(b) using 2-input AND gate

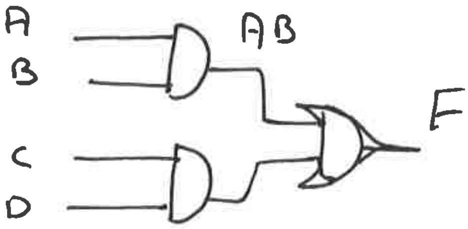


(5) $F = A + B$

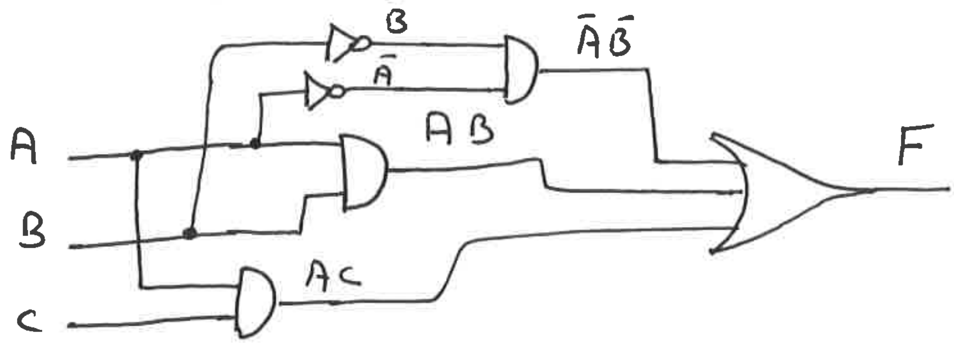
(6) $F = A + B + C$



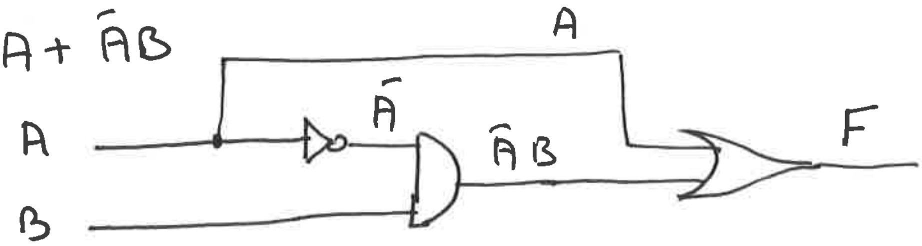
(7) $F = (AB) + (CD)$



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



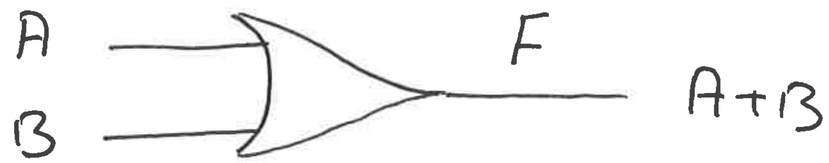
(9) $F = A + \bar{A}B$



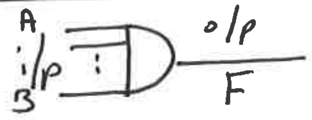
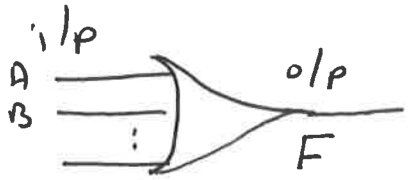
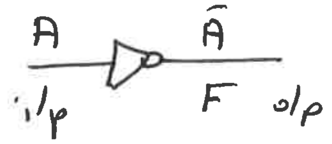
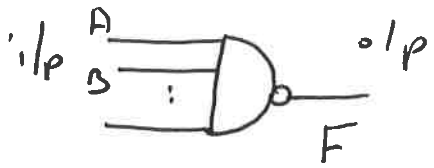
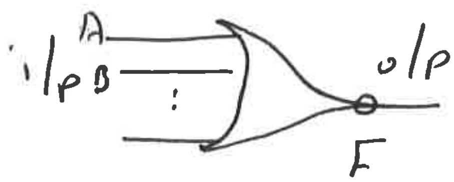
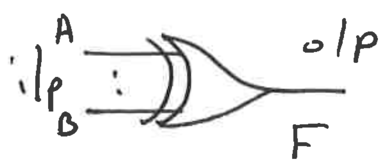
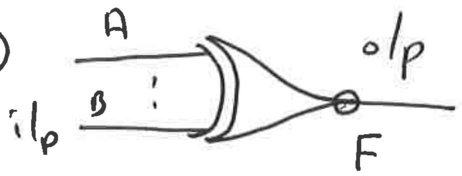
The truth table for the last Function

A	B	$\bar{A}$	$\bar{A}B$	F	(A+B)
0	0	1	0	0	0
0	1	1	1	1	1
1	0	0	0	1	1
1	1	0	0	1	1

$$\therefore \quad A + \bar{A}B \equiv A + B$$



The American Standard Association (ASA) symbols for electronic Logic gates:—

Symbols	Function	Comments
① 	$F = A \cdot B$	AND- gate
② 	$F = A + B$	oR- gate
③ 	$F = \bar{A}$	Not - gate
④ 	$F = \overline{A \cdot B}$	NAND- gate
⑤ 	$F = \overline{A + B}$	NoR-gate
⑥ 	$F = A\bar{B} + \bar{A}B$ $= A \oplus B$	Ex- oR gate
⑦ 	$F = AB + \bar{A}\bar{B}$ $= A \odot B$	Ex- NoR gate

Boolean Algebra :-

Def :- Any Collection $\{A : x+y ;\ x \cdot y ;\ \bar{x} \in A\}$
where A : Set

The operations $(+ ;\ \cdot\ ;\ -)$ together with the following oxioms is called Boolean Algebra.

Equivalent :- 2 Expresions are equivalent when one of them only equal to the other

Ex) $a \cdot b = c \cdot d$

$1 \rightarrow 1$

$0 \rightarrow 0$

Complement :- 2 Expresions are Complement each other when one expression = 1 the other equal = 0, or when 1 expression = 0 the other = 1

The complement of A is $\bar{A}$

Rules of Complements :-

Two complement any (Boolean) expression change.

1. all 0's to 1's.
2. all 1's to 0's.
3. all (+)'s to (·)'s.
4. all (·)'s to (+)'s.

Then :-

Complement each Variable

Ex) $F = A \cdot B + C$

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

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

Ex) $F = A\bar{B}CD + A + BC$

$\bar{F} = \overline{A\bar{B}CD + A + BC}$

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

Duality :-

It states that every algebraic expression deducible from the postulates of Boolean Algebra remains vaild of the operators and identity elements are interchanged.

Rules of Dual :-

change all 0's to 1's

change all 1's to 0's

change all $(\cdot)$'s to $(+)$'s

change all $(+)$'s to $(\cdot)$'s

but Don't Complement the Variable.

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

Dual $F = A + B \cdot \bar{A} + B \cdot C$

Ex) Find the Complement and the Dual of the following

① $A \cdot B$ ② $A + B$ ③ $A \cdot B \cdot C \cdot D$ ④ $A + B + C + D$

Sol:-

	Complement	Dual
①	$\bar{A} + \bar{B}$	$A + B$
②	$\bar{A} \cdot \bar{B}$	$A \cdot B$
③	$\bar{A} + \bar{B} + \bar{C} + \bar{D}$	$A + B + C + D$
④	$\bar{A} \cdot \bar{B} \cdot \bar{C} \cdot \bar{D}$	$A \cdot B \cdot C \cdot D$

Oxioms of Boolean Algebra:-

① IF $X, y \in A$; Then $X + y \in A$; $X \cdot y \in A$; $\bar{X}, \bar{y} \in A$

② IF $X, y \in A$; Then $X \cdot y = y \cdot X$

③ $X, y, z \in A$ Then $X(y + z) = Xy + Xz$

④ IF $X \in A$ $\exists$ (this Exist) $0 \in A$ $\ni$ (such that) $X + 0 = X$

$X + 1 = 1$

⑤ IF $X, y, z \in A$ Then $(X + yz) = (X + y)(X + z)$

⑥ IF $X \in A$ $\exists$ $\bar{X} \in A$ $X \cdot \bar{X} = 0$

$X + \bar{X} = 1$

Postulate:-

1. $x + 0 = x$
2. $x + \bar{x} = 1$ " Complementry Law "
3. $x(y+z) = xy + xz$
4. $x + y = y + x$
5. $x \cdot 1 = x$
6. $x \cdot \bar{x} = 0$
7. $x + yz = (x+y)(x+z)$
8. $y \cdot x = x \cdot y$

Theorms:-

1. $x + x = x$
2. $x + 1 = 1$
3. $x + xy = x$
4. $x + \bar{x}y = y$
5. $z\bar{x}y = zx + zy$
6. $xy + \bar{x}z + yz = xy + \bar{x}z$
7. $x \cdot x = x$
8. $x \cdot 0 = 0$
9. $x(x+y) = x$
10. $\bar{\bar{x}} = x$

Ex) Simplify the following Expressions using Boolean Algebra expr. :-

1. $AB + A(B+C) + B(B+C)$
2. $A + A\cdot\bar{B} + \bar{A}\cdot\bar{B}$
3. $A\cdot B + \overline{AB} + A$

Sol :-

1. $AB + A(B+C) + B(B+C) = AB + AB + AC + B + BC$

$= A(B+C) + B(1+C)$

$= AB + AC + B$

$= B(A+1) + AC$

$= B + AC$

2. $A + A\cdot\bar{B} + \bar{B}\cdot\bar{A} = A(1+\bar{B}) + \bar{A}B$

$= A + \bar{A}B$

$= B$

3. $AB + \overline{AB} + A = 1 + A$

$= 1$

Ex) Simplify the following Function

$F = A\bar{C} + ABC + AC\bar{D} + CD$

$= A(\bar{C} + BC) + C(A\bar{D} + D)$

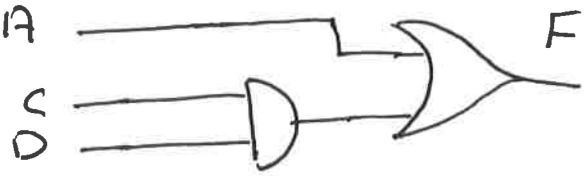
$= A(\bar{C} + B) + C(A + D)$

$= A\bar{C} + AB + AC + CD$

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

$= A + AB + CD$

$= A + CD$



Ex) Simplify the following Function :-

① $F = AB + \bar{A}B\bar{C} + \bar{A}BC$

② $F = \bar{A}\bar{C} * (\bar{B} + BD) + A\bar{C}D$ / H.W

Ex) Simplify the following Function and Find the truth table ?

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

$= AB + AC + \bar{A}B + A\bar{C}$

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

$F = A + B$

A	B	C	$\bar{A}$	$\bar{C}$	$B+C$	$A(B+C)$	$\bar{A}B$	$A\bar{C}$	F	$A+B$
0	0	0	1	1	0	0	0	0	0	0
0	0	1	1	0	1	0	0	0	0	0
0	1	0	1	1	1	0	1	0	1	1
0	1	1	1	0	1	0	1	0	1	1
1	0	0	0	1	0	0	0	1	1	1
1	0	1	0	0	1	1	0	0	1	1
1	1	0	0	1	1	1	0	1	1	1
1	1	1	0	0	1	1	0	0	1	1