Vivekanand College, Kolhapur (Empowered Autonomous)
Department of Electronics

Date: 04/09/2023

Notice
(B.Sc-I Electronics)

All the students of B.Sc-I Electronics are hereby informed that they should write a Home assignment on Unit II (Logic Gates, Boolean algebra) of Digital Electronics-I of total 15 marks and submit to the department on or before 11/09/2023.

Q.1 Short answer questions:

i) Explain any two basic gates with their logic diagram, truth-table and write boolean equations for them (**4 marks**).

ii) Explain derived gates with their logic diagram, truth-table and write boolean equations for them (**3 marks**).

Q.2 Long answer questions: [8 marks]

i) State and prove De-Morgan's theorems with logic symbol and truth-table.

Subject Teacher
(Dr. P. S. Jadhav)

Head of the Department
Dr. C. B. Patil

HEAD
DEPARTMENT OF ELECTRONICS
VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

VIVEKANAND COLLEGE KOLHAPUR · (Empowered Autonomous) · ESTD JUNE 1964

VIVEKANAND COLLEGE, KOLHAPUR (EMPOWERED AUTONOMOUS)

B.Sc - I Electronics Roll Call - 2023 - 24

Assignment

Sr.No.	Roll No.	Student Name	Group	Sub. Total			
1	7250	ATHANE SHREYA DEE[AK	E.P.M.	1	SDAthane		
2	7251	DESAI SARTHAK SAGAR	E.P.M.	2	Not submitted		
3	7252	KALEKAR HARSH VINAYAK	E.P.M.	3	[illegible]		
4	7253	KAMBLE PRAJWAL KIRAN	E.P.M.	4	Kamble		
5	7254	KAMBLE SMITAL VILAS	E.P.M.	5	Not submitted		
6	7255	KATTI PRATHAMESH MAHESH	E.P.M.	6	[illegible]		
7	7256	KAZI MAHAMANDKAIF MAKSUD	E.P.M.	7	Not submitted		
8	7257	KHOPKAR PRATAMESH BABASO	E.P.M.	8	[illegible]		
9	7258	MAHTO SURAJKUMAR SUBHASH	E.P.M.	9	Suraj		
10	7259	MANE DINESH DATTATRAY	E.P.M.	10	Not submitted		
11	7260	NIGADE RUPESH MOHAN	E.P.M.	11	Not submitted		
12	7261	PAWAR SHREYAS SUBHASH	E.P.M.	12	SPawar.		
13	7262	SHINDE RUSHIKESH VINAYAK	E.P.M.	13	[illegible]		
14	7263	WADKAR PRATHMESH ARUN	E.P.M.	14	Not submitted		
15	7222	KAMBLE SAMRAT SURESH	M.E.S.	1	SKamble		
16	7223	LAD AALOK BAJARANG	M.E.S.	2	[illegible]		
17	7224	PATIL VISHWAJEET VIJAY	M.E.S.	3	submitted		
18	7225	POWAR ANIKET PANDURANG	M.E.S.	4	Not submitted		
19	7264	ATTAR NASHRA ABDULLAH	Comp.E.M..	1	NA		
20	7265	BIRJE NAMRATA NARAYAN	Comp.E.M..	2	N.N.Birje		
21	7266	CHARANKAR SHARVARI SANJAY	Comp.E.M..	3	Charankar		
22	7267	CHOUGULE SWEJAL AMAR	Comp.E.M..	4	Chougule		
23	7268	GAIKWAD URVEE UMESH	Comp.E.M..	5	Gaikwad		
24	7269	GURAV SAHIL SAMIR	Comp.E.M..	6	Sahil		
25	7270	KAMBLE SAKSHI SAGAR	Comp.E.M..	7	SKamble		
26	7271	KAMBLE SHRUTIKA BAPU	Comp.E.M..	8	Not submitted		
27	7272	LAHIGADE PARTH SAGAR	Comp.E.M..	9	PLahigade		
28	7273	MNGOLI HANNAH DARWIN	Comp.E.M..	10	[illegible]		
29	7274	MORBALE VAISHNAVI PARSHRAM	Comp.E.M..	11	Vaishnavi		
30	7275	PATIL BHAKTI SAMBHAJI	Comp.E.M..	12	Bpatil		
31	7276	PATIL UTKARSHA NITIN	Comp.E.M..	13	UPatil		
32	7277	PATIL VIRAJ UTTAM	Comp.E.M..	14	Viraj		
33	7278	PEDANEKAR SHIVAJI SATAPPA	Comp.E.M..	15	[illegible]		
34	7279	POWAR SANIKA ASHOK	Comp.E.M..	16	[illegible]		
35	7280	SALOKHE HARSHADA SUREDNRA	Comp.E.M..	17	Not submitted		
36	7281	SAMARTH ALLI ASHRAF	Comp.E.M..	18	Ashraf		
37	7282	SUTHAR MAINA OMPRAKASH	Comp.E.M..	19	[illegible]		

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38	7283	TELEKE NITASI TELEKE	Comp.E.M..	20	NTeleke	
39	7284	TORASKAR SHRADDHA SUBHASH	Comp.E.M..	21	Toraskar	
40	7340	AWATE AKASH SURESH	Comp.E.S.	1	Not submitted	
41	7341	CHOUGALE SAKSHI SANTOSH	Comp.E.S.	2	Chougale	
42	7342	KADAM PRITIKA SURESH	Comp.E.S.	3	P.S. Kadam	
43	7343	KANDALE AMRUTA ANANDRAO	Comp.E.S.	4	AKA	
44	7344	KANUGADE ANUSHKA SHIVLING	Comp.E.S.	5	AKS	
45	7345	KHOT VAIBHAV ANNASO	Comp.E.S.	6	[illegible]	
46	7346	MACHALE OMKAR SANGRAM	Comp.E.S.	7	Machale	
47	7347	MANE SATVIK VIKAS	Comp.E.S.	8	[illegible]	
48	7348	MUJAWAR SALIL SIKANDAR	Comp.E.S.	9	[illegible]	
49	7349	PATIL MADHURA ANANDA	Comp.E.S.	10	[illegible]	
50	7350	PATIL SANIKA DAGADU	Comp.E.S.	11	Sanika	
51	7351	PATIL TEJAS POPAT	Comp.E.S.	12	Patil	
52	7352	SANKPAL ARATI BABAN	Comp.E.S.	13	Sankpal	
53	7353	SUTAR MANISHA BAJARANG	Comp.E.S.	14	MBS	
54	7354	VAGRE ROHAN SANJAY	Comp.E.S.	15	[illegible]	
55	7355	VEER SNEHAL DILIP	Comp.E.S.	16	[illegible]	

Subject Teacher
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Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE, KOLHAPUR (Empowered Autonomous)

B.Sc. Electronics-I 2023-24

Home Assignment Marks Entry out of 15

Sem I

DIGITAL ELECTRONICS-I Unit. Logit Gates and Boolean Algebra

Sr. No.	Roll No.	Marks	Sr. No.	Roll No.	Marks
1	7250	15	29	7274	15
2	7251	0	30	7275	14
3	7252	12	31	7276	15
4	7253	14	32	7277	12
5	7254	0	33	7278	11
6	7255	14	34	7279	14
7	7256	0	35	7280	0
8	7257	12	36	7281	13
9	7258	14	37	7282	15
10	7259	0	38	7283	11
11	7260	0	39	7284	12
12	7261	14	40	7340	0
13	7262	15	41	7341	15
14	7263	0	42	7342	15
15	7222	15	43	7343	15
16	7223	14	44	7344	14
17	7224	15	45	7345	15
18	7225	0	46	7346	11
19	7264	15	47	7347	9
20	7265	15	48	7348	14
21	7266	15	49	7349	15
22	7267	14	50	7350	14
23	7268	15	51	7351	15
24	7269	9	52	7352	15
25	7270	15	53	7353	15
26	7271	0	54	7354	15
27	7272	12	55	7355	14
28	7273	11			

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VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Assignment No - 1

Sub :— Electronics

15/15

Name - Namrata Narayan Birje
class - Bsc-cs-fy
Div :- 'A'
Roll No :- 7265

Q1 Explain basic gates with their logic diagram, truth table and write the boolean equation.

Basic (fundamental) gates -

1] OR gate
2] AND gate
3] NOT gate

1] OR GATE -

As its name implies, an OR logic gate performs an "OR" logic operation, which is an addition. It has at least two inputs So, if A and B are its inputs, at the output we will find (A+B) so OR logic gate can be Summarized by the formula Y = A+B ." If either A or B is true, then Q is true".

logic Diagram -

Two p input OR gate Symbol

Truth table -

Inputs		outputes
A	B	Q = A+B
0	0	0
0	1	1
1	0	1
1	1	1

Truth table of OR gate.

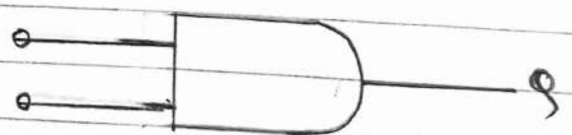
Boolean Equation :-

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

2] **AND GATE :-**

As its name implies, an AND ga logic gate performs an "AND" logic operation which in an multiplication It has at least two inputs, so if A and B are its inputs, at the output we will find (A×B). So AND logic gate Can be Summarized by the formula $Y = A \times B$.
"If both A and B are true, then q is true".

Logic Diagram :-



Two input AND gate Symbol.

Truth table :-

Inputs		outputes
A	B	Q = ~~A+B~~ AB
0	0	0
0	1	1
1	0	1
1	1	1

Truth table of ~~or gate~~. AND gate

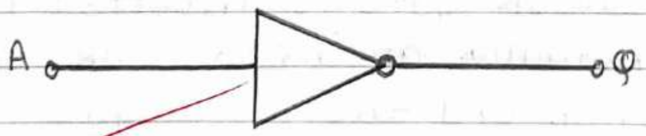
Boolean equation :-

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

3) NOT GATE :-

As the name implies, inverter will invert the number entered If you enter "0", you will get a "1" on its output, and if you enter a "1" you will get a "0" on its output The inverter Symbol is Shown in fig 2.3. Inverter gate is also known as NOT and it output is $Y = \overline{A}$.

Logic Diagram -



NOT gate symbol

Truth table -

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

Truth table of NOT gate

Booleon Equation -

$$\boxed{Y = \overline{A}}$$

Q 2 Explain derived gates with their logic diagram Truth table and write the boolean equation

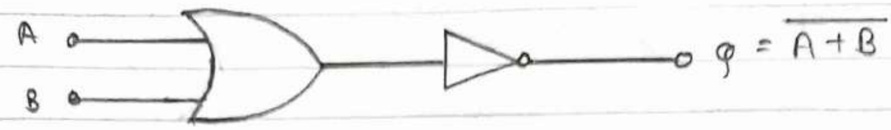
Derived Gates -

1] NOR gate
2] NAND gate
3] Ex-OR gate

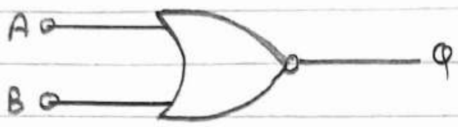
1] NOR GATE -

NOR gate means NOT- OR gate. In a NOR gate, an OR gate is inverted through a NOT gate. Actually an inverted OR operation is NOR operation and the logic gat performing this operation is called NOR gate. A NOT gate followed by an OR gate makes a NOR gate the basic logic Construction of the NOR gate is shown below.

logic diagram -



a] - Logic circuit of NOR gate.



b] Symbol

Truth table -

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

Truth table of NOR gate

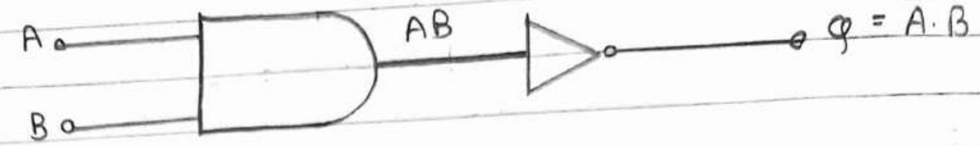
Boolean Equation -

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

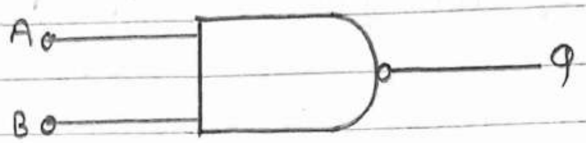
2] NAND GATE -

when output of an AND gate is inverted through a NOT gate, the operation is called NAND operation. The logic gate which performs this ANAND operation is called NAND gate A NOT gate followed by an AND gate makes a NAND gate the basic logical Construction of the NAND gate is shown below.

Logical diagram -



a] Logic circuit of NAND gate.



b] Symbol

Truth table -

Inputs		output
A	B	$Q = \overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

Truth table of NAND gate.

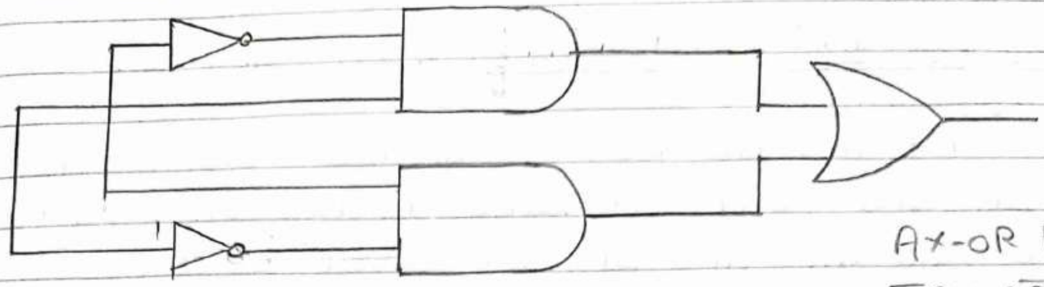
Boolean Equation -

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

3] EX-OR GATE -

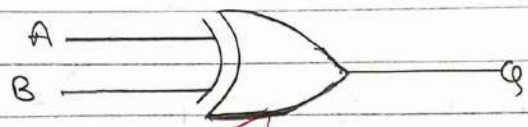
The gate performs This modulo Sum operation without including carry is known as Ex-oR gate An Ex-oR gate is normally two inputed logic gate where, output is only logical 1 when only one input is logical 1 when both inputs are equal, that is either both are 1 or both are 0, the output will be logical 0.

Logical diagram -



A x-OR B
$= \overline{A}B + A\overline{B}$

a] logic circuit of Ex-OR gate.



b] Symbol

Truth table

Inputs		output
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

Truth table of Ex-oR gate

In general ouput is high when odd number of inputs goes high

Boolean Equation -

$$\boxed{Y = A \oplus B}$$

Q3 State and prove De-Morgan's Theorem

DE- MORGAN'S THEOREM-

De margon has Suggested two theorem which are extermely used in Boolean algebra The two theorems are discussed below.

· De-margon's first theorem-

Statment-

The Complement of the product of two Variables is equal to the sum of the Complement of each variable.

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

proof -

1] when $A = 0$, $B = 0$

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

$= \overline{0}$

$= 1$

and $\overline{A} + \overline{B} = \overline{0} + \overline{0}$

$= 1 + 1$

$= 1$

and $\overline{A} + \overline{B} = \overline{0} + \overline{0}$

$= 1 + 1$

$= 1$

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

2] when $A = 0$, $B = 1$

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

$= \overline{0}$

$= 1$

and $\overline{A} \cdot \overline{B} = \overline{0} + \overline{1}$

$= 1 + 0$

$= 1$

3] when $A = 1$, $B = 0$

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

$= \overline{0} = 1$

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

$= 0 + 1$

$= 1$

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

4] when $A = 1$, $B = 1$

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

$= \overline{1}$

$= 0$

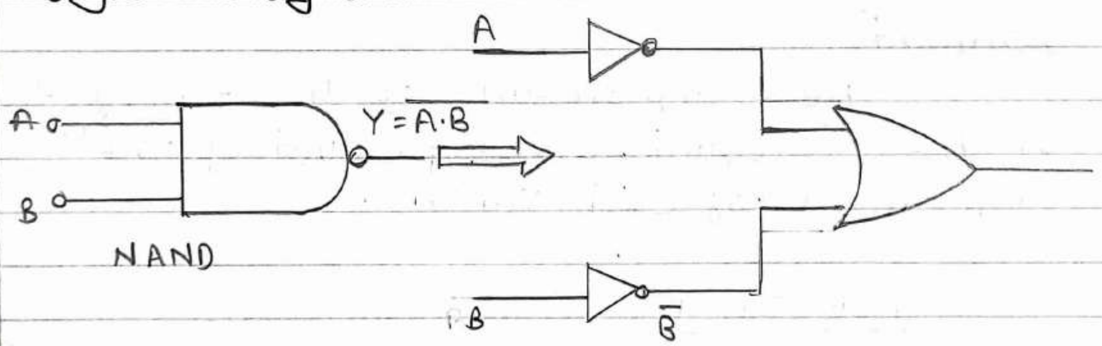
and $\overline{A} + \overline{B} = \overline{1} + \overline{1}$

$= \overline{0} + 0$

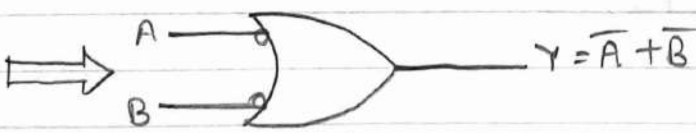
$= 0$

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

Logical diagram-



NAND $\equiv$ Bubbled oR



Bubbled oR

Logical Diagram

(Implementation.)

Truth table -

Input A	Input B	output $\overline{AB}$	output $\overline{A}+\overline{B}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

Truth table of first theorem

Boolean Equation -

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

· De-Morgan's Second Theorem -

Statment -
The Complement of the Sum of two variables is equal to the product of the Complement of each Variable

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

proof -

1] when $A=0$, $B=0$

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

and $\overline{A\cdot B} = \overline{0}\cdot\overline{0}$

$$= 1\cdot 1$$
$$= 1$$

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

2] when $A=0$, $B=1$

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

$= \overline{1}$

$= 0$

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

$= 1 \cdot 0$

$= 0$

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

3] when $A = 1,\ B = 0$

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

$= \overline{1}$

$= 0$

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

$= 0 \cdot 1$

$= 0$

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

4] when $A = 1,\ B = 1$

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

$= \overline{1}$

$= 0$

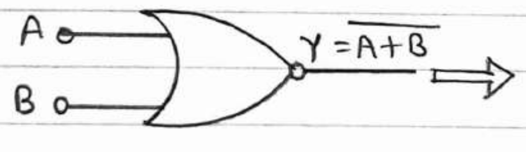
and $\overline{A}\cdot\overline{B} = \overline{1}\cdot\overline{1}$

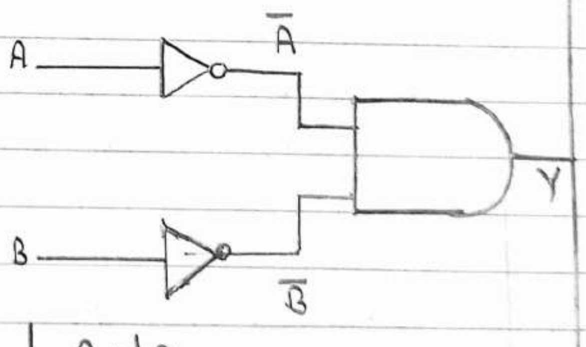
$= 0 \cdot 0$

$= 0$

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

Logical diagram -





NOR

NOR $\equiv$ Bubbled AND

Bubbled AND

Logic diagram (implementation)

Truth table -

A	B	$\overline{A+B}$	$\overline{A \cdot B}$
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

Truth table of second theorem

Boolean Equation -

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

Madhura Ananda Patil

7349

15/15

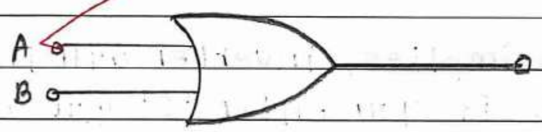
Assignment - I

Q.1. Explain basic gates with their logic diagram, Truth table and write boolean expression

There are three basic gates.
OR, AND, NOT

1. OR Gate:

As it's name implies, and or logic gates performs an 'OR' logic operation, which is an addition. It has at least two input, so. if A and B are it's inputs, at the output . we will find (A+B). So or logic gate can be summarized by the formula Y = A + B then Q is true.



. Two input OR gate symbol

Truth Table of OR Gate.

Input		Output
A	B	Q = A + B
0	0	0
0	1	1
1	0	1
1	1	1

4

2. AND Gate

As its name implies. an AND logic gates performs an 'AND' logic operation, which is an multiplication. It has at least two inputs. So, if A and B are it's inputs, at the output will find (A X B). So AND Logic gate can be summarized by the formula Y = A X B "If both A & B are true, then Q is true"

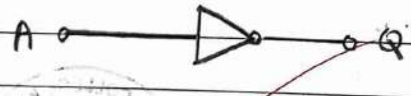
Two input AND gate symbol

Truth table of AND Gate.

Inputs		output
A	B	Q = AB
0	0	0
0	1	0
1	0	0
1	1	1.

The NOT Gate:

As the name implies, inverter will invert the number entered. If you enter '0' you will get a "1" on it's output. and if you enter a '1'. You will get a "0" on it's output. The inverter symbol is shown in fig. Inverter gate is also known as NOT and its output is $Y = \bar{A}$.



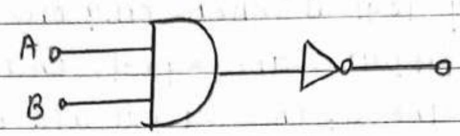
Truth Table of NOT gate.

Input	Output
A	$Q = \bar{A}$
0	1
1	0

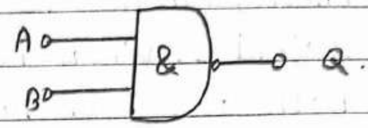
Q.2 The NAND Gate:-

When output of an AND Gate is inverted through a NOT Gate, the operation is called NAND Gate operation

The logic gate which performs this NAND operation is called NAND gate. A NOT gate followed by an AND gate makes a NAND gate. The basic logical construction of the NAND gate is shown below.



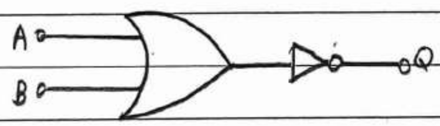
Logic circuit of NAND Gate.



symbol

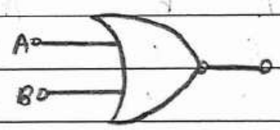
The NOR Gate:

NOR gates means NOT-OR gate in a NOR gate, an OR gate is inverted through a NOT gate. Actually an inverted OR operation is NOR operation and the logic gate performing this operation is called NOR gate. A NOT gate followed by an OR gate makes a NOR gate. The basic logic construction of the NOR gate is shown below,



$= \overline{A+B}$

Logic circuit of NOR gate



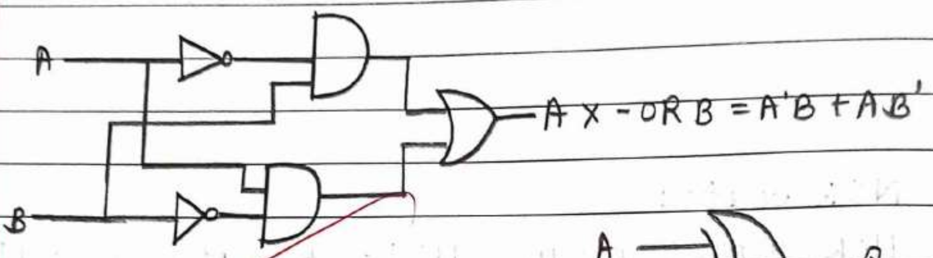
symbol

Truth table of NOR gate.

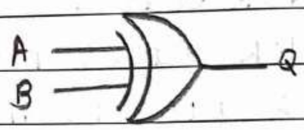
Inputs		Output
A	B	$Q = \overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

The Ex-OR Gate:

The gate performs this modulo sum operation without including carry is known as EX-OR gate. An Ex-OR gate is normally two inputs logic gate where, output is only logical 1 when only one input is logical 1. When both inputs are equal, that is either both are 1 or both are 0, the output will be logical 0.



Logic circuit Ex-OR gate



symbol

Truth Table of Ex-OR gate

Input		Output
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

In general output is high when odd no. of input goes high.

Q. 2. ~~Explain~~ derive the gates with logic diagram, Truth table and write boolean expression.

Q.3. ~~Explain~~ state & prove Demorgan's Theorem

De Morgan's Theorem

De Morgan's has suggested two therems which are exteemly useful in Boolean algebra. The two theorems are discussed below.

Theorem 1:

The complement of the product of two variables is equal to the sum of the complement of each variables.

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

Proof:

i) when $A=0$, $B=0$

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

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

ii) When $A=0$, $B=1$

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

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

iii) when $A=1$, $B=0$

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

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

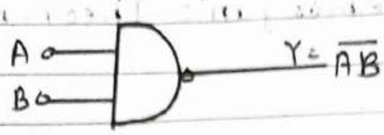
Hence $\overline{A \cdot B} = \overline{A} + \overline{B}$

iv) When $A=1$, $B=1$

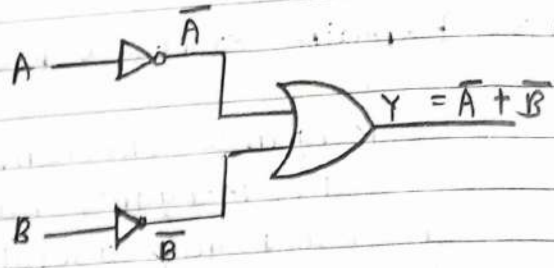
$$\overline{A \cdot B} = \overline{1 \cdot 1} = \overline{1} = 0$$

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

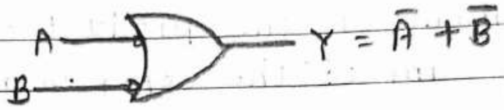
Hence $\overline{A \cdot B} = \overline{A} + \overline{B}$



NAND



NAND $\equiv$ Bubbled OR



Bubbled OR

Truth table of first theorem

A	B	$\overline{AB}$	$\overline{A} + \overline{B}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

Theorem 2:

The compliment of the sum of two variables is equal to the product of the complement of each variable.

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

Proof:

i) when $A = 0$, $B = 0$

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

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

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

When $A = 1, B = 0$

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

and $\overline{A}.\overline{B} = \overline{1}.\overline{0} = 0.1 = 0$

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

When $A = 1, B = 0$

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

$\overline{A}.\overline{B} = \overline{1}.\overline{0} = 0.1 = 0$

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

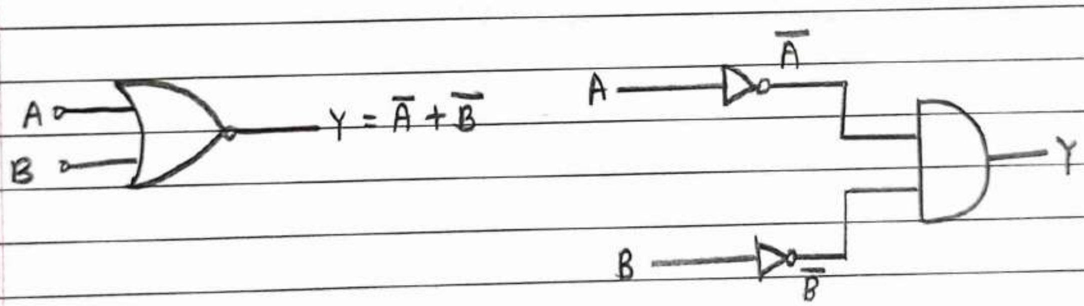
When $A = 1, B = 1$

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

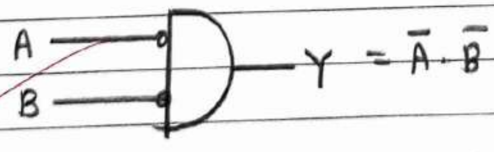
$\overline{A}.\overline{B} = \overline{1}.\overline{1} = 0.0 = 0$

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

Logic Diagram :



NOR ≡ Bubbled AND



Truth table of 2nd Theorem

A	B	$\overline{A+B}$	$\overline{A}.\overline{B}$
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

Assignmet No - 1

Name :- Vishwajeet Vijay Patil.
Sub :- Electronics.
Roll No :- 7224.
Std :- Bsc. FY.

Q.1. Explain Basic Gates with their logic diagram thruth table and ~~wet~~ write the bullian expression form.

→ Their are three types of gates OR, AND & Not gates.

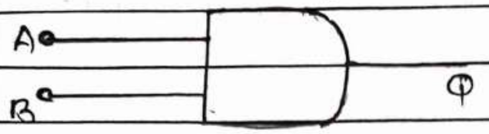
1] The OR Gate :- As its name implies, an OR logic gate performs an 'OR' logic operations, which is an addition. It has at least two inputs. So, if A and B are its inputs, at the output we will find (A+B). so OR logic gate can be summarized by the formula Y= A+B. "If either A or B is true, then Q is true."

symbol of OR gate.

Truth table.

Inputs		Output
A	B	Q = A+B.
0	0	0
0	1	1
1	0	1
1	1	1

2] The AND Gate :- As it name implies, an AND logic gate performs an "AND" logic operation, which is an multiplication. It has at least two inputs. So if A and B are its inputs, at the output we will find (A×B). So And logic gate can be summarized by the formula Y= A×B. "If both A and B are truth then Q is true"

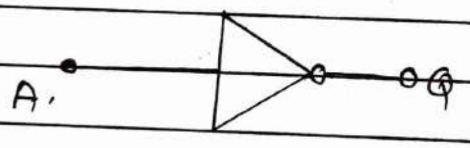


Symbol of AND gate.

Truth table

Inputs		Output
A	B	A·B
0	0	0
0	1	0
1	0	0
1	1	1

3] The NOT gate :- As the name implies, inverter the number entered. If you enter '0' you will get a "1" on its output, and if you enter a "1" you will get a "0" on its output. The inverter symbol is shown in given table Inverter gate is also known as NOT and its output is $Y = \bar{A}$.



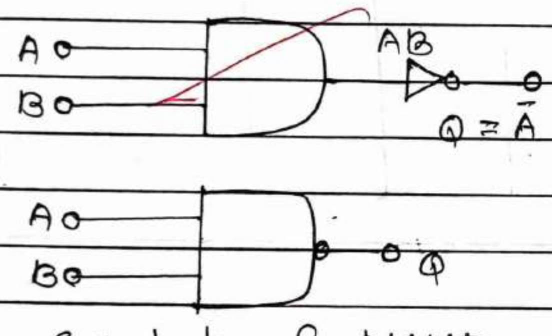
Symbol of NOT gate.

Truth table

Inputs	Output
A	$Q = \bar{A}$
0	1
1	0

Q.2. Explain derived gates with their logic diagram truth table and write the bullian expression form of it.

1] The NAND Gate :- When output of an NAND gate is inverted through a NOT gate, the operation is called NAND operation. The logic gate which performs this NAND operation is called NAND gate. A NOT gate followed by an AND gate makes NAND gate. The basic logical construction of the NAND gate is shown below.

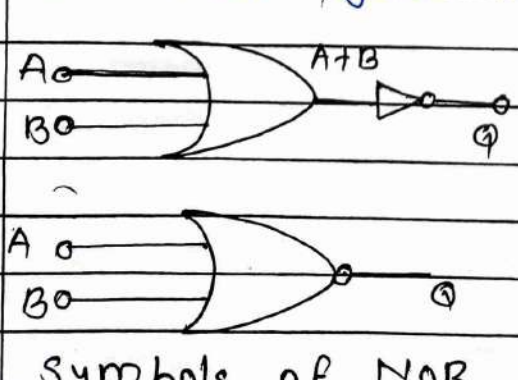


Symbols of NAND gate.

Truth table.

Inputs		Output
A	B	$Q = \overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

2]. The NOR Gate :- NOR gate means NOT - OR gate. In a NOR gate, an OR gate is inverted through a NOT gate. Actually an inverted OR operation is NOR operation and the logic gate performing this operation is called NOR gate. A NOT gate followed by an OR gate makes a NOR gate. The basic logic construction of the NOR gate is shown below.

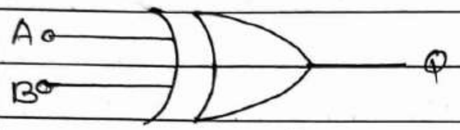


Symbols of NOR Gate.

Truth table.

Inputs		Output
A	B	$Q = \overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

3] The EX-OR gate :- The gate performs this modulo sum operations without including carry is known as Ex-OR Gate. An Ex-OR gate is normally two inputs logic gate where, output is only logical 1 when only one input is logical 1 when both inputs are equal, that is either both are 1 or both are 0, the output will be logical 0.



symbol of Ex-OR gate.

Truth table.

Inputs		output.
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

Q.3. State and proved Demorgan's Theorem.

The complement of the product of two varibles is equal to the sum of the complement of each variable.

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

proof :-

(i) When $A = 0$, $B = 0$

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

and $\bar{A} + \bar{B} = \bar{0} + \bar{0} = 1 + 1 = 1$

Hence, $\overline{A \cdot B} = \bar{A} + \bar{B}$.

(ii) When $A = 0$, $B = 1$

$\overline{A \cdot B} = \overline{0 \cdot 1} = \bar{0} = 1$.

and $\bar{A} + \bar{B} = \bar{0} + \bar{1} = 1 + 0 = 1$

Hence, $\overline{A \cdot B} = \bar{A} + \bar{B}$.

(iii) When $A = 1$, $B = 0$.

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

and $\bar{A} + \bar{B} = \bar{1} + \bar{0} = 0 + 1 + 1$

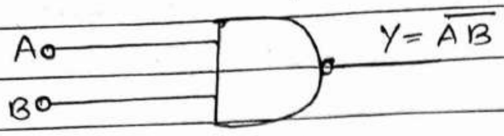
Hence $\overline{A \cdot B} = \bar{A} + \bar{B}$.

iv) When $A = 1$, $B = 1$

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

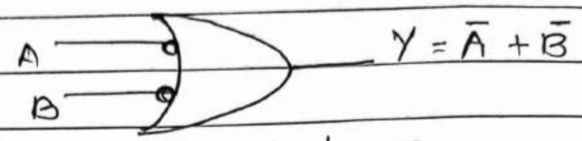
and $\bar{A} + \bar{B} = \bar{1} + \bar{1} = 0 + 0 = 0$

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



NAND

$\rightarrow$ NAND —— Bubbled OR



Bubbled OR.

Truth table of first theorem

A	B	$\overline{A \cdot B}$	$\overline{A} + \overline{B}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

Theorem 2 end.

The complemet of the sum of two variables is equal to the product of the complement of each variable.

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

proof :-

(i) When $A = 0$, $B = 0$.

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

and $\overline{A} \cdot \overline{B} = \overline{0} \cdot \overline{0} = 1 \cdot 1 = 1$.

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

(ii) When $A = 0$, $B = 1$

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

and $\overline{A} \cdot \overline{B} = \overline{0} \cdot \overline{1} = 1 \cdot 0 = 0$.

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

(iii) When $A = 1$, $B = 0$

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

and $\overline{A} \cdot \overline{B} = \overline{1+0} = \overline{1} = 0$

Hence, $\overline{A+B} = \overline{A} \cdot \overline{B}$.

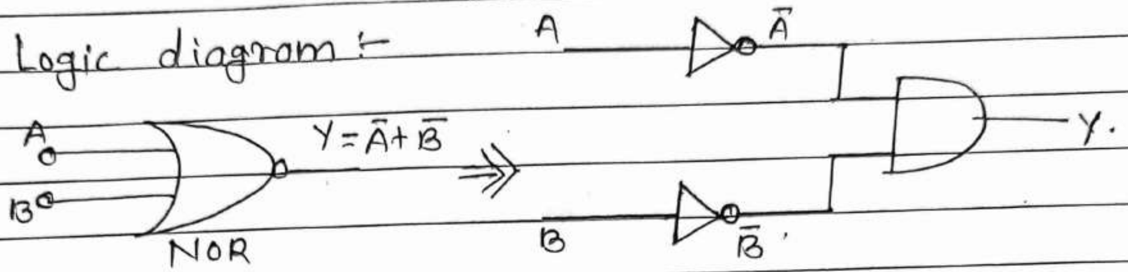
(iv) When $A = 1$, $B = 1$

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

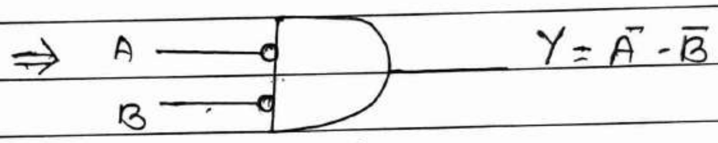
and $\bar{A} \cdot \bar{B} = \bar{1} \cdot \bar{1} = 0 \cdot 0 = 0$

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

Logic diagram :-



NOR ═ Bubbled AND.



Bubbled AND.

Truth table of 2nd Theorem

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

8

PAGE NO.:
DATE: / /

15/15

Sub :- Electronics.

Name :- sakshi sagar kamble.
class :- BSC - CS. FY
Div :- 'A'
Roll No :- 7270.

Assignment No - 1

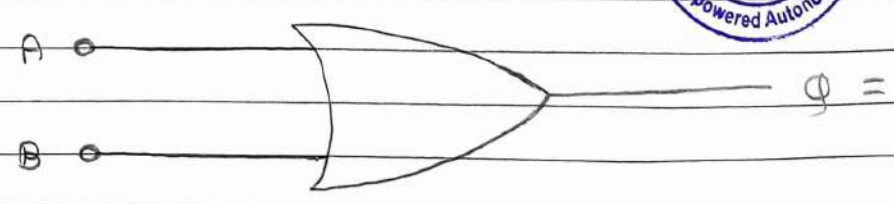
Q.1) Explain basic gates with their logic diagram, truth table and write the boolean equation.

Basic (Fundamental) gates :-
1) OR gate
2) AND gate
3) NOT gate.

1) OR Gate :- As its name implies, an OR logic gate performs an "OR" logic operation which is an addition. It has at least two inputs, so if A and B are its inputs at the output we will find (A+B) so OR logic gate can be summarized by the formula $Y = A + B$. " If either A or B is true, then Q is true."

4

Logic Diagram :-



Two ~~Point~~ input OR gate symbol.

Truth table :-

Inputs		Outputs
A	B	$Q = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

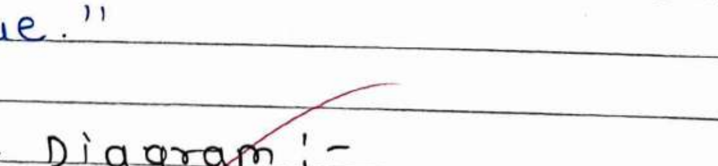
Truth table of OR gate.

Boolean equation :-

$$\boxed{Y = A + B.}$$

2) AND GATE :- As it's name impiles, an AND logic gate performs an "AND" logic operation, which is an multiplication It has at least two inputs so, if A and B are its inputs, at the output we will find $(A \times B)$, So AND logic gate Can be Summarized by the Formula $Y = A + B$ "If both A and B are true, then Q is true."

Logic Diagram :-



Two input AND gate Symbol.

PAGE NO.:
DATE: / /

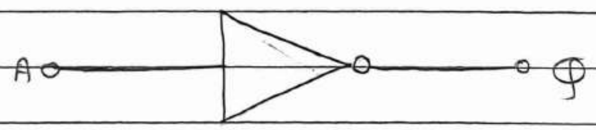
Truth Table :-

inputs		output
A	B	$Q = AB$
0	0	0
0	1	0
1	0	0
1	1	1

Truth table of AND gate.

3) NOT GATE :- As the name implies, inverter, will invert the number entered. If you enter "0", you will get a "1" on it's output, and if you enter a "1", you will get a "0" on its output. The inverter symbol is shown in fig. 2.3. Inverter gate is also known as NOT and it output is $Y = \overline{A}$.

Logic Diagram :-



NOT gate symbol.

Truth table :-

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

Truth table of NOT Gate.

PAGE NO.:
DATE: / /

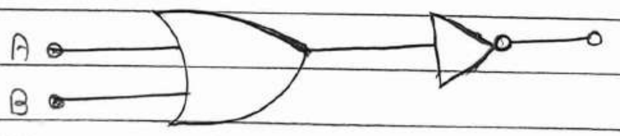
Boolean equation :- $\boxed{y = \overline{A}}$

Q.2) Explain derived gates with their logic diagram, truth table and write the boolean equation.

Derived Gates.
1) NOR gate
2) NAND gate
3) Ex-OR gate.

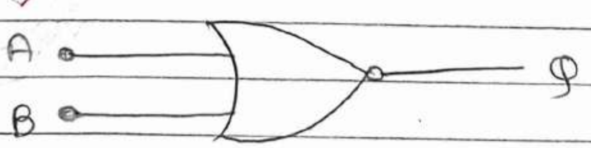
1) NOR Gate :- NOR gate means NOT - OR gate. it ~~is~~ a ~~q~~ NOR gate, an OR gate is inverted through a NOT gate. Actually an inverted OR operation is NOR operation and the logic gate performing this operation is called NOR gate. A NOT gate followed by an OR gate makes a NOR gate. The basic logic construction of the NOR gate is shown below.

logic diagram :-



$Q = \overline{A + B}$

a) logic circuit of NOR gate.



b) symbol.

Truth table :-

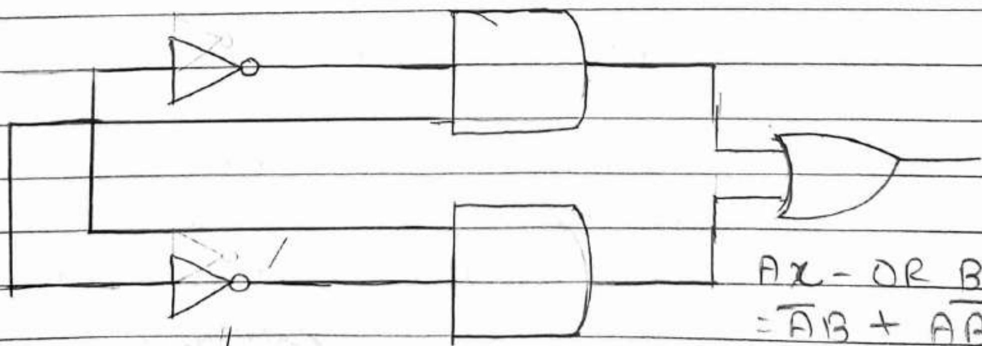
Inputs A	Inputs B	Output $y = \overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

Truth Table of NAND gate.

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

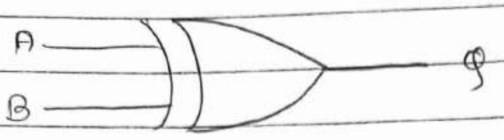
3) EX-OR GATE :- The gate performs this modulo sum operation without including carry is known as EX-OR gate. An Ex-OR gate is normally two inputs logic gate where, output is only logical 1 when only one input is logical 1. When both inputs are equal, that is either both are 1 or both ~~are~~ or 0, the output will be logical 0.

logical Diagram :-



$A \; x\text{-}OR \; B$
$= \overline{A}B + A\overline{B}$

a) logic circuit of Ex-OR gate



b) symbol

Truth table :-

Inputs		output
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

Truth table of Ex-OR gate In general output is high when ~~a~~ odd number of inputs goes high.

Boolean equation :-

$$\boxed{Y = A \oplus B}$$

Q.3) State and prove De-Morgan's Theorem.

DE-MORGAN's Theroem :-

De-Morgan has suggested two theorems which are ~~exte~~ extremly used in Boolean algebras. The two theorems are discussed below.

De Morgan's first Theorem :-

Statement :- The complement of the product of two variables is equal to the sum of the complement of each variable.

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

proof = 1) when $A = 0$, $B = 0$

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

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

8

Hence, $\overline{A\cdot B} = \overline{A}+\overline{B}$

2) when $A = 0$, $B = 1$

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

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

Hence, $\overline{A\cdot B} = \overline{A}+\overline{B}$

3) when $A = 1$, $B = 0$

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

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

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

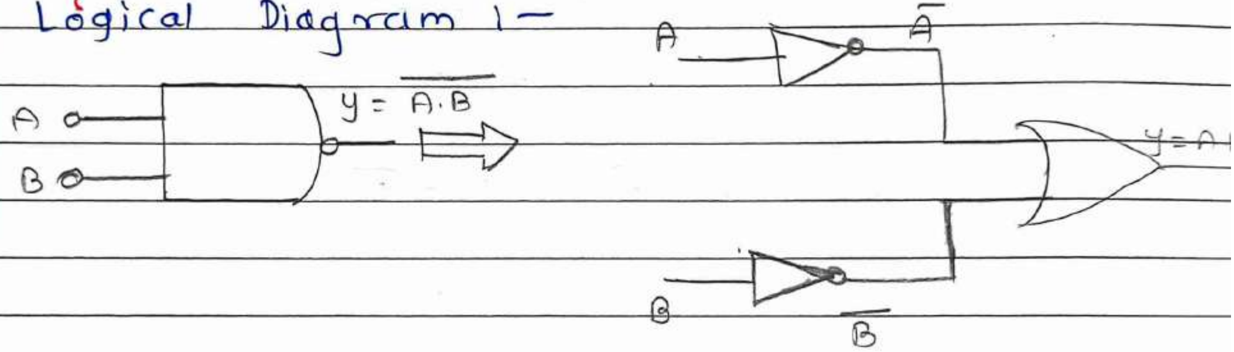
4) when $A = 1$, $B = 1$

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

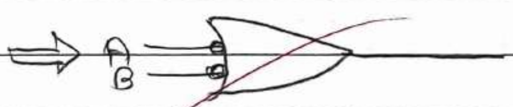
and $\overline{A} + \overline{B} = \overline{1} + \overline{1}$
$$= \bar{0} + 0$$
$$= 0$$

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

Logical Diagram :-



NAND $\equiv$ Bubbled OR



Bubbled OR.

logical Diagram.
(implementation).

DATE: / /

Truth Table :-

Inputs		output	
A	B	$\overline{A.B}$	$\overline{A}+\overline{B}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

Truth table of first Theorem.

Boolean equation :-

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

· De - Morgan's second Theorem :-

statement :- The complement of the sum of two variables is equal to the product of the complement of each variable.

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

Proof :- 1) when $A = 0$, $B = 0$

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

and $\overline{A}.\overline{B} = \overline{0} . \overline{0} = 1 . 1 = 1$

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

2) when $A = 0$, $B = 1$

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

$= \overline{1}$

$= 0$

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

$= 1 \cdot 0$

$= 0$

Hence, $\overline{A+B} = \overline{A} \cdot \overline{B}$

3) when $A = 1$, $B = 0$

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

$= \overline{1}$

$= 0$

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

$= 0 \cdot 1$

$= 0$

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

4) when $A = 1$, $B = 1$

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

$= \overline{1}$

$= 0$

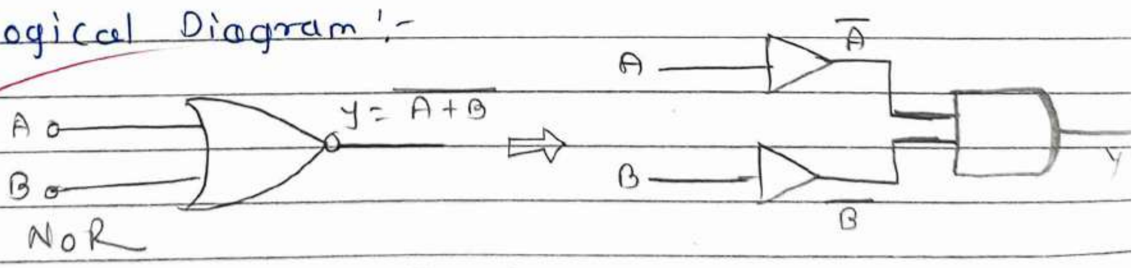
and $\overline{A} \cdot \overline{B} = \overline{1} \cdot \overline{1}$

$= 0 \cdot 0$

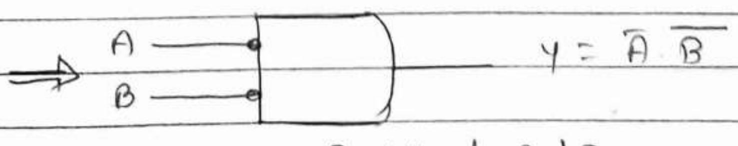
$= 0$

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

logical Diagram :-



NOR ≡ Bubbled AND



Bubbled AND

logic diagram (implementation)

PAGE NO.:
DATE: / /

Truth Table :-

A	B	$\overline{A+B}$	$\overline{A}\cdot\overline{B}$
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

Truth table of second Theorem.

Boolean equation. :-

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

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Page No.
Date

15/15

Digital: Logic Gates

Q.1. Explain basic gates with their logic diagram, truth table and boolean exp equation.

→ a. OR gate.

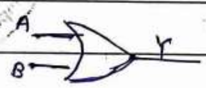
This is a basic logic gate that has two or more inputs and only one output. The logic statement is that when atleast one input is high, the output will be high. since the OR gate performs OR logic operations.

The boolean equation is $y(\text{output}) = A+B$.
where A & B are inputs.

Truth table:

A	B	(A+B) Y
0	0	0
0	1	1
1	0	1
1	1	1

4

Logic Symbol: 

b. AND gate.

The AND gate operates on the principle that the output is high only when both inputs are high as it performs AND operation.

The boolean equation is given by $y(\text{output}) = A \cdot B$.
where, A & B are inputs. This gate can have two or more inputs.

Logic symbol: 

Truth table :

A	B	Y(A+B)
0	0	0
0	1	0
1	0	0
1	1	1

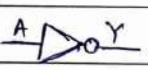
c. NOT gate.

This gate only takes one input and output - the complement of the input. It therefore gives high output only when input is low.

The boolean equation is $Y = \overline{A}$ where A is input and Y is output

Truth table :

A	Y
0	1
1	0

Logic symbol : 

Q.2. Explain derived gates with their logic symbol, truth table and boolean equations.

→

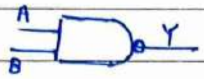
a. NAND gate.

This is a logic gate that is a combination of NOT & AND basic gates. It outputs the complement of the product of the inputs therefore the output is high when atleast one input is low.

The boolean equation is $Y = \overline{A \cdot B}$ where A & B are inputs and Y is the output.

Truth table :

A	B	$Y(\overline{A \cdot B})$
1	1	1
1	0	0
0	1	1
0	0	1

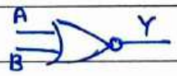
Logic symbol : 

b. NOR gate

This gate is derived from a connection of a NOT & OR gates. It outputs the compliments of the sum of the inputs when both inputs are low, the output is high. The boolean equation is $Y = \overline{A+B}$, where Y is output and A & B are inputs.

Truth table :

A	B	$Y(\overline{A+B})$
1	1	0
1	0	0
0	1	0
0	0	1

Logic symbol : 

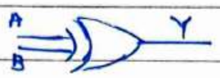
c. EX-OR gate

This is a gate derived from a connection of all three basic logic gates. This gate outputs the value of one input when the other input is '0'. & when one when one input is '1' it outputs the complement of the second input. This means the output is high only when one input is low & other is high.

The boolean equation is $Y = A \oplus B = \bar{A} \cdot B + A \cdot \bar{B}$.

Truth table :

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

Logic symbol : 

Q.3. State & prove De-Morgan's Theorems.

→

1. DeMorgan's First Theorem:

It states that the compliment of a product is equal to the sum of individual complements and is shown as the logical equation. $\overline{A \cdot B} = \overline{A} + \overline{B}$.

To prove this, four laws are examined to show LHS = RHS.

Law 1: where A=0 & B=0

$\overline{A \cdot B} = \overline{0 \cdot 0} = \overline{0} = 1 \qquad \overline{A} + \overline{B} = \overline{0} + \overline{0} = 1 + 1 = 1$

Law 2: where A=0 & B=1

$\overline{A \cdot B} = \overline{0 \cdot 1} = \overline{0} = 1 \qquad \overline{A} + \overline{B} = \overline{0} + \overline{1} = 1 + 0 = 1$

3: where A=1 & B=0

$\overline{A \cdot B} = \overline{1 \cdot 0} = \overline{0} = 1 \qquad \overline{A} + \overline{B} = \overline{1} + \overline{0} = 0 + 1 = 1$

4: where A=1 & B=1

$\overline{A \cdot B} = \overline{1 \cdot 1} = \overline{1} = 0 \qquad \overline{A} + \overline{B} = \overline{1} + \overline{1} = 0 + 0 = 0$

In all four statements $\overline{A \cdot B}$ is equal to $\overline{A} + \overline{B}$, Thus LHS = RHS.

2. De Morgan's Second Theorem.

It states that the complement of the sum of the two binary digits is equal to the product of each digits' complement. And is shown by the given logical equation as $\overline{A+B} = \overline{A}\cdot\overline{B}$.

when $A = 1$ & $B = 0$

$$\overline{A+B} = \overline{A}\cdot\overline{B}$$
$$\overline{1+0} = \overline{1}\cdot\overline{0}$$
$$\overline{1} = 0\cdot 1$$
$$0 = 0 \qquad \therefore LHS = RHS.$$

when $A = 0$ & $B = 0$

$$\overline{A+B} = \overline{A}\cdot\overline{B}$$
$$\overline{0+0} = \overline{0}\cdot\overline{0}$$
$$\overline{0} = 1\cdot 1$$
$$1 = 1 \qquad \therefore LHS = RHS$$

when A & B are 1

8

$$\overline{A+B} = \overline{A}\cdot\overline{B}$$
$$\overline{1+1} = \overline{1}\cdot\overline{1}$$
$$\overline{1} = 0\cdot 0$$
$$0 = 0 \qquad \therefore LHS = RHS$$

when $A = 0$ & $B = 1$

$$\overline{A+B} = \overline{A}\cdot\overline{B}$$
$$\overline{0+1} = \overline{0}\cdot\overline{1}$$
$$\overline{1} = 0\cdot 1$$
$$0 = 0 \qquad \therefore LHS = RHS$$