UNIT-4

LOGIC FUNCTION AND BOOLEAN ALGEBRA

Q.1 What is Boolean algebra? Who invented the concept of Boolean algebra?

Boolean algebra is the logical algebra with two value system of logic that determines the logical prepositions in terms of True or False. The famous English mathematician George Boole invented the concept of Boolean algebra in 1854 AD.

Q.2 Define Boolean operator . Construct truth table of AND operator , OR operator and NOT operator.

Boolean operator is a symbol that performs and indicates any operation between two or more operands. There are the basic three operators in Boolean function. They are:

a. AND operator:

b. OR operator:

c. NOT operator:

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a) AND operator: **AND operator in Boolean function is represented by ".". The result in AND operator will be true if when all the inputs are true.**

Input (A.B)	Output (result)	Note: Where 0 = false 1 = true
0.0	0	
1.0	0	
0.1	0	
1.1	1	

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b) OR operator: **OR operator in Boolean function is represented by "+". The result in OR operator will be true if any one input is true.**

Input (A+B)	Output (result)	Note: Where 0 = false, 1 = true
0+0	0	
1+0	1	
0+1	1	
1+1	1	

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c) NOT operator: The result or output of NOT operator will be just reverse or complement of Boolean Input.

Input (A)	Output (result)	**Note:** Where, 0 = False 1 = True
0	1	
1	0	

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3. What is logic gate? Explain the basic gates of digital computer.

The logic gate is an electronic circuit to receive more than one input and deliver single output. Gates are often called logic circuits because they can be analyzed with Boolean algebra.

There are three basic gates in digital computer. They are:

a. AND gate

b. OR gate

c. NOT gate

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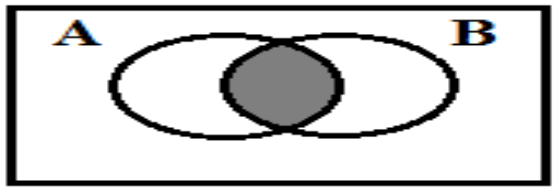
a) AND gate: This is a type of logic gate which produces high (1) or True output when all inputs are high (1), otherwise the output will be low (0) or false.

AND Operator :

The Graphical Symbol



Venn Diagrams

Algebraic expression: X = A.B

Inputs		Outputs	Where,
A	B	X = A.B	0 = False (low)
0	0	0	1 = True (high)
0	1	0	
1	0	0	
1	1	1	

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b) OR gate: This is a type of logic gate, which produces high (1) or true output when any one of the input is high (1) or true. IN this gate, if all the inputs are low (0) or false then the output will be low (0) or false.

Algebraic expression: X = A+B

Inputs		Outputs	Where,
A	B	X = A.B	0 = False (low)
0	0	0	1 = True (high)
0	1	1	
1	0	1	
1	1	1	

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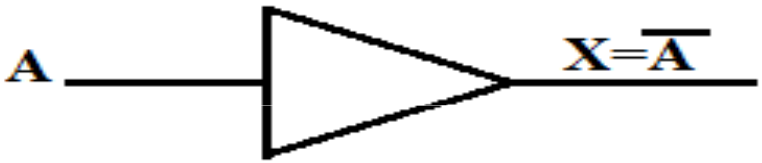
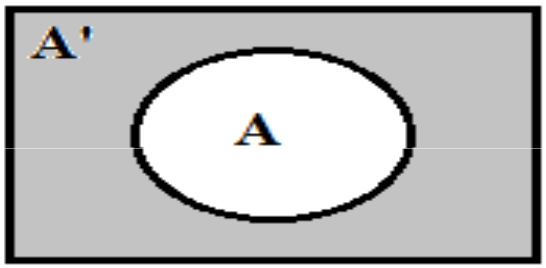
c) NOT gate: This is a type of logic gate in which the output will be the complement of just reverse of input. If the input will be low (0) or false the output will be high (1) or true and vice versa.

NOT Operator :



The Graphical Symbol



Venn Diagrams

Algebraic expression: X = A'= A

Input	Output	Where,
A	$\bar{A}$	0 = False (low)
0	1	1 = True (high)
1	0	

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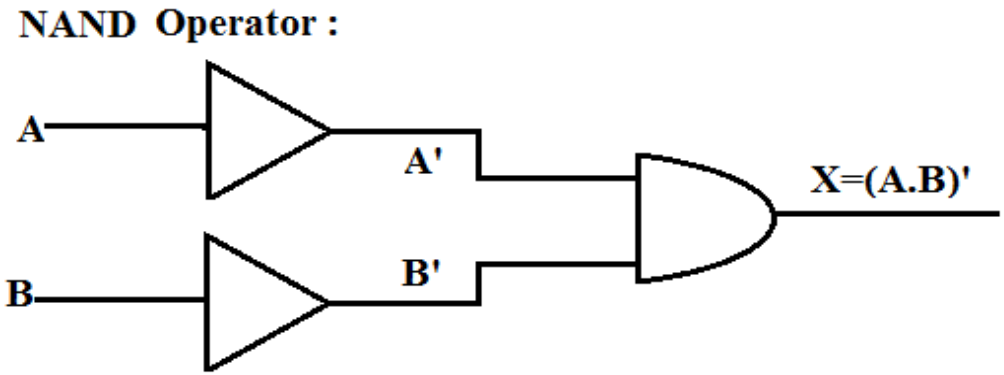
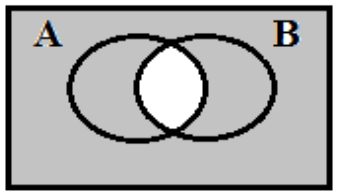
4. Explain NAND gate and NOR gate with truth table:

a) NAND gate:

The NAND gate is the combination of AND gate and NOT gate. i.e. it is the complement of AND gate. This gate produces low (0) output, when all inputs are high (1) otherwise the output will be high (1).



The Graphical Symbol



Venn Diagrams

Algebraic expression: X = (A.B)'

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Truth Table

Inputs		Output 1 X = A.B	Output 2 X = (A.B)'	Where, 0 = False (low) 1 = True (high)
A	B			
0	0	0	1	
0	1	0	1	
1	0	0	1	
1	1	1	0	

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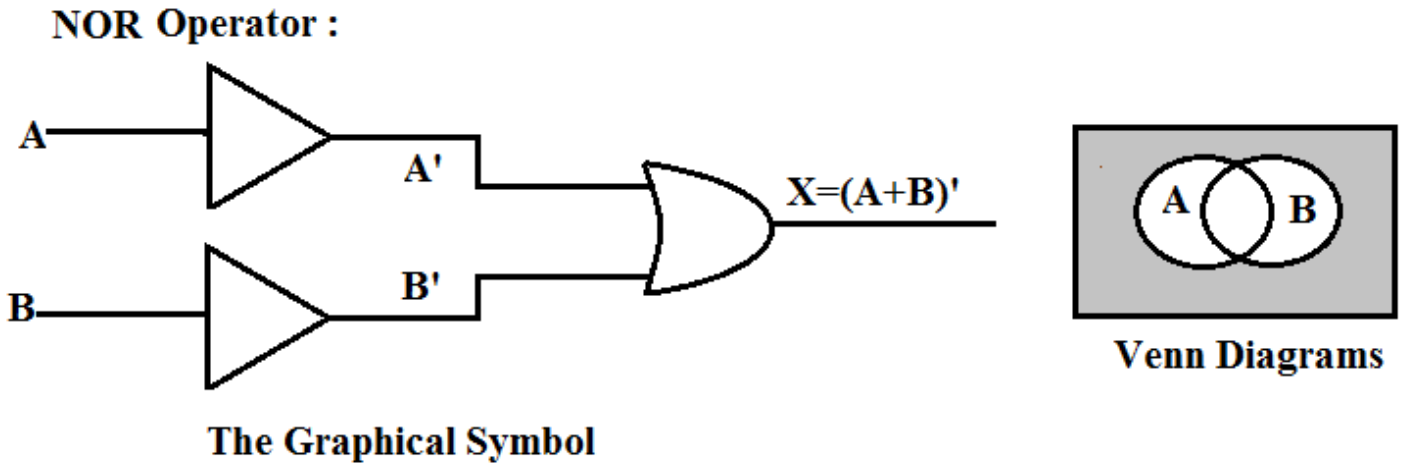
NOR gate:

This is the combination of OR and NOT gate i.e. it is the complement of OR gate. This gate produces high (1) output when all inputs are low (0) otherwise, the output will be low (0).



The Graphical Symbol

Algebraic expression: X = (A+B)'

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Truth Table

Inputs		Output 1	Output 2
A	**B**	**A+B**	**A+B'**
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

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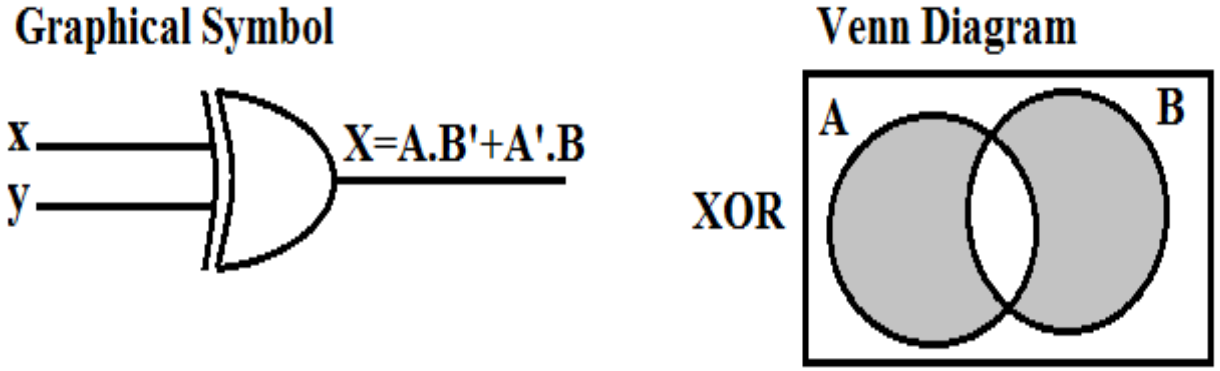
5. What are X-OR and X-NOR gate? Explain with truth table.

X-OR gate:

This is exclusive OR gate which produces low (0) output when all the inputs are same otherwise, the output will be high (1).



Algebraic expression: X = A.B' + A'.B

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Truth Table

Inputs		Output
A	**B**	**A.B' + A'.B**
0	0	0
0	1	1
1	0	1
1	1	0

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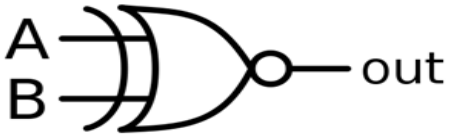
X-NOR gate:

The exclusive gate is just complement of X-OR gate which produces high (1) output when all the inputs are either low (0) or high (1).

Graphical Symbol



Algebraic expression: X = A.B + A'.B'

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Truth Table

Input		Output
A	**B**	**X = A.B + A'.B'**
0	0	1
0	1	0
1	0	0
1	1	1

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6. Why are NAND and NOR gate called universal gate?

The NAND and NOR gates are called to be universal gates because these gates are sufficient to implement any Boolean function. The combination of NAND gate can be used to perform AND and NOT operation. Similarly, the combination of NOR gate can be used to perform OR and NOT operation.

7. Write the importance of gates in computer architecture?

Importance of gate in computer architecture: The main part of computer system is processor, and the processor is connected with various components like as I/O devices, storage devices, and many other components. Data and instructions are transmitted form one component to other components in the form of pulse trains. Various tasks are performed by passing trains through electronic gates. The gate controls flow of pulses in a particular direction, so, sometimes it is also called black box. Therefore, there is a great importance of gate in computer architecture.

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8. Explain De Morgan's Theorem with truth table.

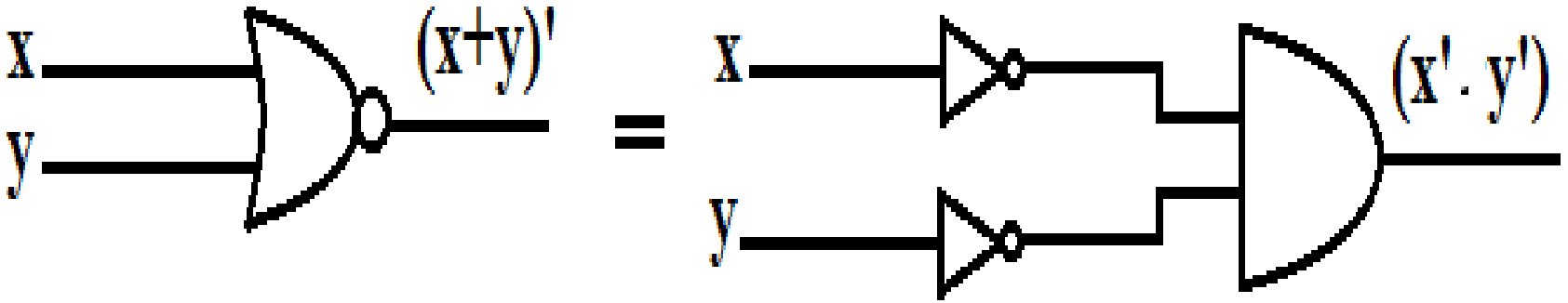
De Morgan's Theorem:

De Morgan was a great mathematician and logician who gave two important theorems for applying in logic gates:

a. De Morgan's First Theorem:

"The complement of a sum is equals to the product of the complement." i.e. (x+y)' = x' . y'

Graphical symbol:



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Truth Table

According to above truth table the output 1 (x+y)' is equal to output 2 (x'-y').

Inputs			Output 1			Output 2
x	y	x+y	(x+y)'	x'	y'	x'.y'
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

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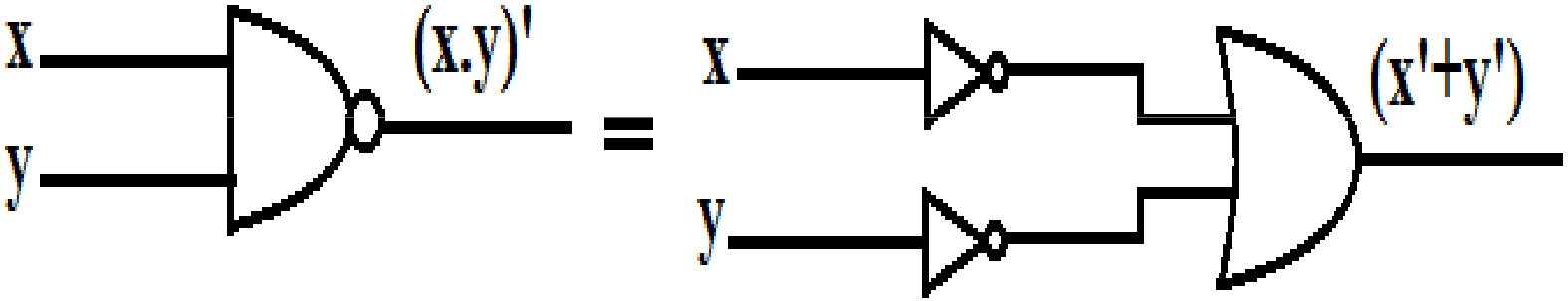
b. De Morgan's Second Theorem:

"The complement of a product is equal to the sum of the complement."

i.e. (x.y)' = x' + y'

Graphical symbol:



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Truth Table

According to above truth table the output 1 (x.y)' is equal to output 2 (x'+y').

Inputs			Output 1			Output 2
x	y	x.y	(x.y)'	x'	y'	x' + y'
0	0	0	1	1	1	1
0	1	0	1	1	0	1
1	0	0	1	0	1	1
1	1	1	0	0	0	0

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9. Write short notes on:

a. Boolean function:

A Boolean function is an expression formed with binary variables, the two binary operators OR and AND, the unary operator NOT, parentheses and equal sign.

Example: Boolean function F1 = (abc')

The function F1 is equal to 1 if a = 1 AND b = 1 AND c' = 1, otherwise F = 0.

The Boolean function is represented as an algebraic expression. It may also be represented in truth table.

Truth table for AND:

A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

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b. Proposition:

A proposition is a statement which identifies any true or false declarative sentence. It can be represented by using 'P' or 'q' letters.

c. Negative:

When a statement is presented by its contradiction then such statement is known as negative statement.

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THANK YOU !

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