CHAPTER NO. 06

COMPUTER LOGIC AND GATES

EXERCISE

Short Question

Q.No. 01: What is a logic gate?
Ans: Logic gates are the basic building blocks of any digital system. It is an electronic circuit having one or more than one input and only one output. The relationship between the input and the output on certain logic. Based on this, logic gates are named as AND, OR, and NOT gates etc.

Q.No. 02: Define Truth table.
Ans: Truth table is tabular representation of values for inputs and their corresponding outputs. It shows all possible outcomes that would occur from all possible scenarios. It is used for logic problems as in Boolean algebra and electronic circuits.

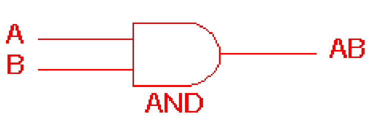
Q.No. 03: Define Boolean function.
Ans: *Boolean function:-* A Boolean function is an expression formed with binary variables, the logical operators(OR, AND and NOT), parenthesis and equal sign. A binary variable can take the value 0 or 1. For a given value of the variables, the function can be either 0 or 1.
Example
F=x+y
If x and y are 0 the f will be 0 otherwise the function will be 1.

Q.No. 04: What is Karnaugh map and why is it used?
Ans: *Karnaugh Map:-* Karnaugh map was introduced by Maurice Karnaugh in 1953. It provides a simple method for simplifying Boolean functions. When a simplified Boolean function is converted into a logic circuit, it requires less number of gates and hence costs less.
Why Karnaugh Map is use:- Karnaugh map are used to simplify real-world logic requirements so that they can be implemented using a minimum number of physical logic gates. A sum of products expression can always be implemented using AND gates feeding into an OR gate, and a product of sums expression leads to OR gates feeding an AND gate.

Q.No. 05: Draw three –variable Karnaugh map for variables x,y and z.

Extensive Questions

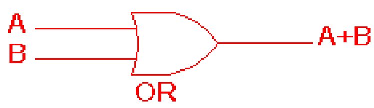
Q.No. 01: Draw the graphical symbols of AND, OR , NOT , NAND and NOR gates and write their functions.
Ans: *Draw graphical Symbols of AND gate:-*



2 Input AND gate		
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

Function of AND gate:- In the above graphical diagram the input terminals are left and output terminals are at right. The output is true when both inputs are true, otherwise the output is false.

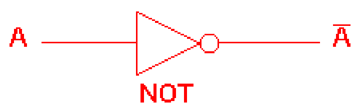
Draw graphical Symbols of OR gate:-



2 Input OR gate		
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

Function of OR gate:- The output is true, if either or both of the inputs are true. If both inputs are false then the output is false.

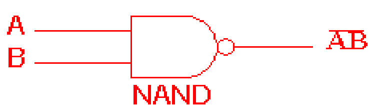
Draw graphical Symbols of NOT gate:-



NOT gate	
A	$\overline{A}$
0	1
1	0

Function of NOT gate:- It has only one input, it reverse the logic state.

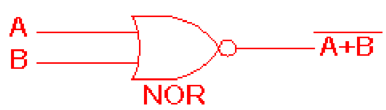
Draw graphical Symbols of NAND gate:-



2 Input NAND gate		
A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

Function of NAND gate:- The NAND gate operates as an AND gate followed by a NOT gate. The output is false if both inputs are true, otherwise the output is true.

Draw graphical Symbols of NOR gate:-

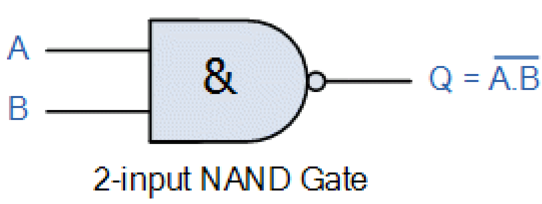


2 Input NOR gate		
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

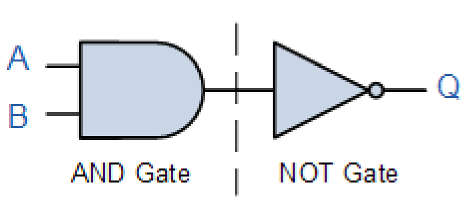
Function of NOR gate:- NOR gate is a combination of OR gate and followed by an inverter. Its output is true, if both inputs are false, otherwise output is false.

Q.No. 02: Explain how NAND and NOR gates can be created using AND, OR and NOT gates.

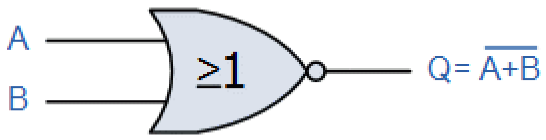
Ans: Logic NAND Function: The Logic NAND Function output is only false when all of its inputs are true, otherwise the output is always true.



The NAND or "Not AND" function is a combination of the two separate logical functions, the AND function and the NOT function in series. The logic NAND function can be expressed by the Boolean expression of $A.B$



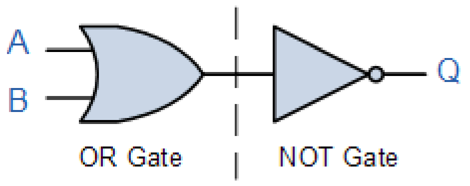
Logic NOR Function: The Logic NOR Function output is only true when all of its inputs are false, otherwise the output is always false.



2-input NOR Gate

The NOR or "Not OR" gate is also a combination of two separate logic functions, Not and OR connected together to form a single logic function which is the same as the OR function except that the output is inverted.

To create a NOR gate, the OR function and the NOT function are connected together in series with its operation given by the Boolean expression as, $A + B$



Q.No. 03: Draw truth table of the following Boolean functions.

1. $F_1 = \overline{x}y\overline{z}+\overline{x}yz+xy\overline{z}$

x	y	z	$\overline{x}$	$\overline{y}$	$\overline{z}$	$\overline{x}y\overline{z}$	$\overline{x}yz$	$xy\overline{z}$	F_1
1	1	1	0	0	0	0	0	0	0
1	1	0	0	0	1	0	0	1	1
1	0	1	0	1	0	0	0	0	0
1	0	0	0	1	1	0	0	0	0
0	1	1	1	0	0	0	1	0	1
0	1	0	1	0	1	1	0	0	1
0	0	1	1	1	0	0	0	0	0
0	0	0	1	1	1	0	0	0	0

ii. $F_2 = \overline{x}z + y\overline{z} + xyz$

x	y	z	$\overline{x}$	$\overline{y}$	$\overline{z}$	$\overline{x}z$	$y\overline{z}$	xyz	F_2
1	1	1	0	0	0	0	0	1	1
1	1	0	0	0	1	0	1	0	1
1	0	1	0	1	0	0	0	0	0
1	0	0	0	1	1	0	0	0	0
0	1	1	1	0	0	1	0	0	1
0	1	0	1	0	1	0	1	0	1
0	0	1	1	1	0	1	0	0	1
0	0	0	1	1	1	0	0	0	0

iii. $F_3 = \overline{x}\overline{y}\overline{z} + \overline{x}\overline{y}z + \overline{x}yz + xy\overline{z}$

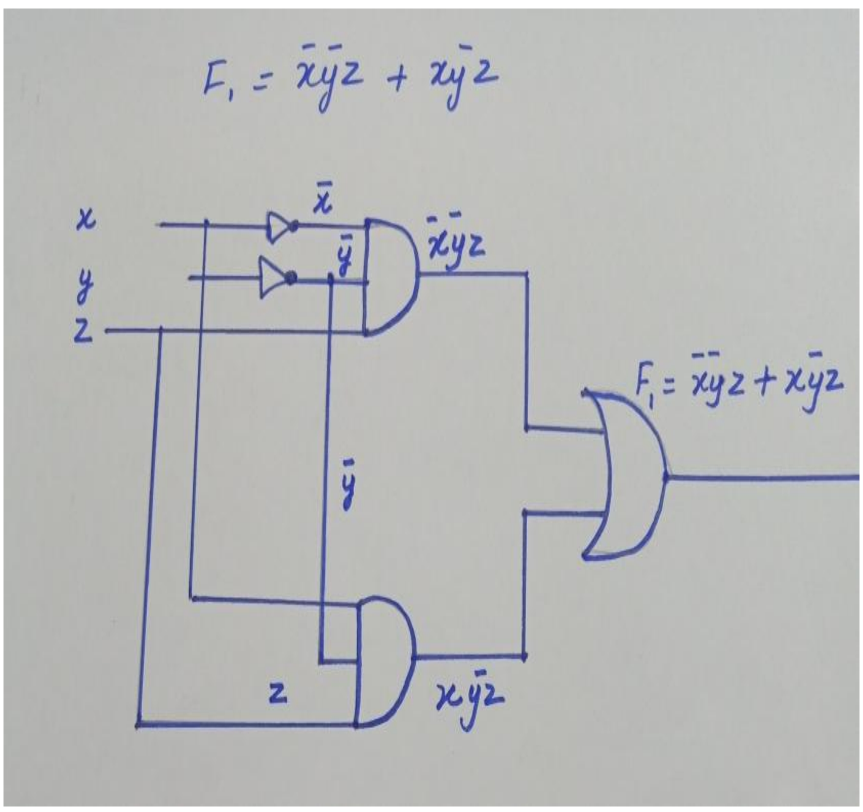
x	y	z	$\overline{x}$	$\overline{y}$	$\overline{z}$	$\overline{x}\overline{y}\overline{z}$	$\overline{x}\overline{y}z$	$\overline{x}yz$	$xy\overline{z}$	F_3
1	1	1	0	0	0	0	0	0	0	0
1	1	0	0	0	1	0	0	0	1	1
1	0	1	0	1	0	0	0	0	0	0
1	0	0	0	1	1	0	0	0	0	0
0	1	1	1	0	0	0	0	1	0	1
0	1	0	1	0	1	0	0	0	0	0
0	0	1	1	1	0	0	1	0	0	1
0	0	0	1	1	1	1	0	0	0	1

4. $F_4 = x\overline{z} + \overline{x}\,\overline{y}$

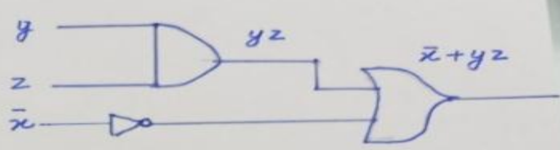
x	y	z	$\overline{x}$	$\overline{y}$	$\overline{z}$	$x\overline{z}$	$\overline{x}\overline{y}$	F_4
1	1	1	0	0	0	0	0	0
1	1	0	0	0	1	1	0	1
1	0	1	0	1	0	0	0	0
1	0	0	0	1	1	1	0	1
0	1	1	1	0	0	0	0	0
0	1	0	1	0	1	0	0	0
0	0	1	1	1	0	0	1	1
0	0	0	1	1	1	0	1	1

Q.No. 04 & 05: Draw the logic circuits and K-Map of the following:

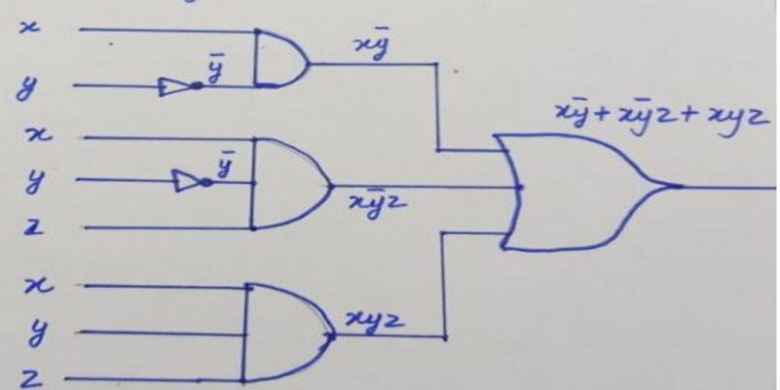
Ans:



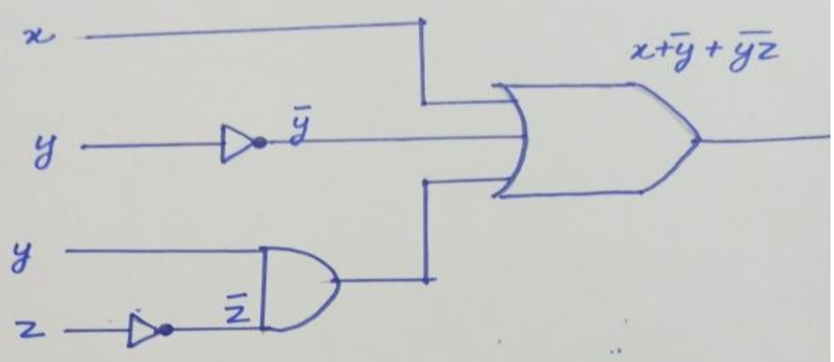
$F_2 = \bar{x} + yz$



$F_3 = x\bar{y} + x\bar{y}z + xyz.$



$F_4 = x + \bar{y} + y\bar{z}$



K-Map.

$F_1 = \bar{A}B\bar{C} + \bar{A}BC + AB\bar{C}$

	$\bar{B}$	$\bar{B}$	B	B
$\bar{A}$	$\bar{A}\bar{B}\bar{C}$	$\bar{A}\bar{B}C$	$\bar{A}BC$	$\bar{A}B\bar{C}$
A	$A\bar{B}\bar{C}$	$A\bar{B}C$	ABC	$AB\bar{C}$
	$\bar{C}$	C	C	$\bar{C}$

		1	1
			1

$\boxed{\bar{A}B + B\bar{C}}$ Ans.

$$F_2 = \bar{A}C + B\bar{C} + ABC$$

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

$$\bar{A}BC + \bar{A}\bar{B}C + AB\bar{C} + \bar{A}B\bar{C} + ABC.$$

	1	1	1
		1	1

$$B + \bar{A}C$$

$$F_3 = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC + AB\bar{C}$$

1	1	1	
			1

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

$$F_4 = A\bar{C} + \bar{A}\bar{B}$$

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

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

1	1		
1			1

$$\bar{A}\bar{B} + A\bar{C}$$