Logic Gates

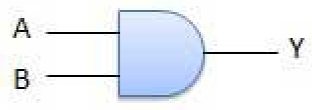
Logic gates are the basic building blocks of any digital system. It is an electronic circuit having one or more than one input and only one output. The relationship between the input and the output is based on a **certain logic**. Based on this, logic gates are named as AND gate, OR gate, NOT gate etc.

AND Gate

A circuit which performs an AND operation is shown in figure. It has n input (n >= 2) and one output.

Y	=	A AND B AND C .... N
Y	=	A.B.C .... N
Y	=	ABC .... N

Logic diagram



Truth Table

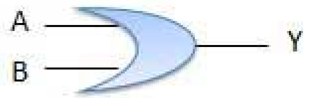
Inputs		Output
A	B	AB
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate

A circuit which performs an OR operation is shown in figure. It has n input (n >= 2) and one output.

Y	=	A OR B OR C .... N
Y	=	A + B + C .... N

Logic diagram



Truth Table

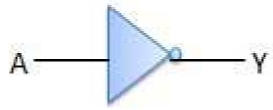
Inputs		Output
A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate

NOT gate is also known as **Inverter**. It has one input A and one output Y.

Y	=	NOT A
Y	=	$\overline{A}$

Logic diagram



Truth Table

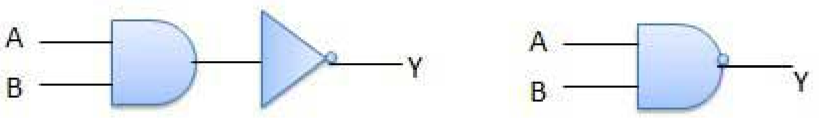
Inputs	Output
A	B
0	1
1	0

NAND Gate

A NOT-AND operation is known as NAND operation. It has n input (n >= 2) and one output.

Y	=	A NOT AND B NOT AND C .... N
Y	=	A NAND B NAND C .... N

Logic diagram



Truth Table

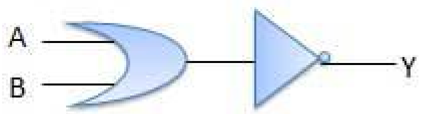
Inputs		Output
A	B	$\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

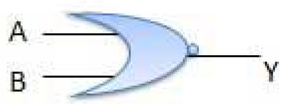
NOR Gate

A NOT-OR operation is known as NOR operation. It has n input (n >= 2) and one output.

Y	=	A NOT OR B NOT OR C .... N
Y	=	A NOR B NOR C .... N

Logic diagram





Truth Table

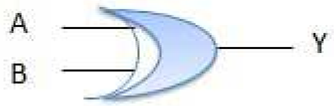
Inputs		Output
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

XOR Gate

XOR or Ex-OR gate is a special type of gate. It can be used in the half adder, full adder and subtractor. The exclusive-OR gate is abbreviated as EX-OR gate or sometime as X-OR gate. It has n input (n >= 2) and one output.

Y	=	A XOR B XOR C .... N
Y	=	$A \oplus B \oplus C$ .... N
Y	=	$\overline{AB} + \overline{AB}$

Logic diagram



Truth Table

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

XNOR Gate

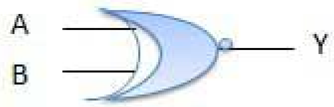
XNOR gate is a special type of gate. It can be used in the half adder, full adder and subtractor. The exclusive-NOR gate is abbreviated as EX-NOR gate or sometime as X-NOR gate. It has n input (n >= 2) and one output.

$$Y = A \text{ XOR } B \text{ XOR } C \ldots\ldots. N$$

$$Y = A \odot B \odot C \ldots\ldots. N$$

$$Y = \bar{A}\bar{B} + AB$$

Logic diagram



Truth Table

Inputs		Output
A	B	$A \odot B$
0	0	1
0	1	0
1	0	0
1	1	1

MCQs

Q1. The universal gate is ………………

1. NAND gate
2. OR gate
3. AND gate
4. None of the above

Ans. 1

Q2. The inverter is ……………

1. NOT gate
2. OR gate
3. AND gate
4. None of the above

Ans. 1

Q3. The inputs of a NAND gate are connected together. The resulting circuit is ………….

1. OR gate
2. AND gate
3. NOT gate
4. None of the above

Ans. 3

Q4. The NOR gate is OR gate followed by ………………

1. AND gate
2. NAND gate
3. NOT gate
4. None of the above

Ans. 3

Q5. The NAND gate is AND gate followed by …………………

1. NOT gate
2. OR gate
3. AND gate
4. None of the above

Ans. 1

Q6. Digital circuit can be made by the repeated use of ………………

1. OR gates
2. NOT gates

3. NAND gates
4. None of the above

Ans. 3

Q7. The only function of NOT gate is to ……………..

1. Stop signal
2. Invert input signal
3. Act as a universal gate
4. None of the above

Ans. 2

Q8. When an input signal 1 is applied to a NOT gate, the output is ………………

1. 0
2. 1
3. Either 0 & 1
4. None of the above

Ans. 1

Q9. In Boolean algebra, the bar sign (-) indicates ………………..

1. OR operation
2. AND operation
3. NOT operation
4. None of the above

Ans. 3

Q10. An OR gate has 4 inputs. One input is high and the other three are low. The output is …….

1. Low
2. High
3. alternately high and low
4. may be high or low depending on relative magnitude of inputs

Ans. 2

Q11. Both OR and AND gates can have only two inputs.

1. True
2. False

Ans. 2

Q12. The output will be a LOW for any case when one or more inputs are zero in a/an …………

1. OR Gate
2. NOT Gate
3. AND Gate
4. NAND Gate

Ans. 3

Q13. A single transistor can be used to build …………. gates .

1. OR Gate
2. NOT Gate
3. AND Gate
4. NAND Gate

Ans. 3

Q14. The logic gate that will have HIGH or "1" at its output when any one of its inputs is HIGH is a/an …………… gate.

1. OR Gate
2. NOT Gate
3. AND Gate
4. NAND Gate

Ans. 1

Q15. …………. NAND circuits are contained in a 7400 NAND IC.

1. 1
2. 2
3. 4
4. 8

Ans. 3

Q16. Exclusive-OR (XOR) logic gates can be constructed from ………..logic gates.

1. OR gates only
2. AND gates and NOT gates
3. AND gates, OR gates, and NOT gates
4. OR gates and NOT gates

Ans. 3

Q17. ……….. truth table entries are necessary for a four-input circuit.

1. 4
2. 8
3. 12
4. 16

Ans. 4

Q18. A NAND gate has …….. inputs and ……. output.

1. LOW inputs and LOW outputs
2. HIGH inputs and HIGH outputs
3. LOW inputs and HIGH outputs
4. None of these

Ans. 3

Q19. The basic logic gate whose output is the complement of the input is ………….

1. OR gate
2. AND gate
3. INVERTER gate
4. Comparator

Ans. 3

Q20. ……….. input values will cause an AND logic gate to produce a HIGH output.

1. At least one input is HIGH
2. At least one input is LOW
3. All inputs are HIGH
4. All inputs are LOW

Ans. 3