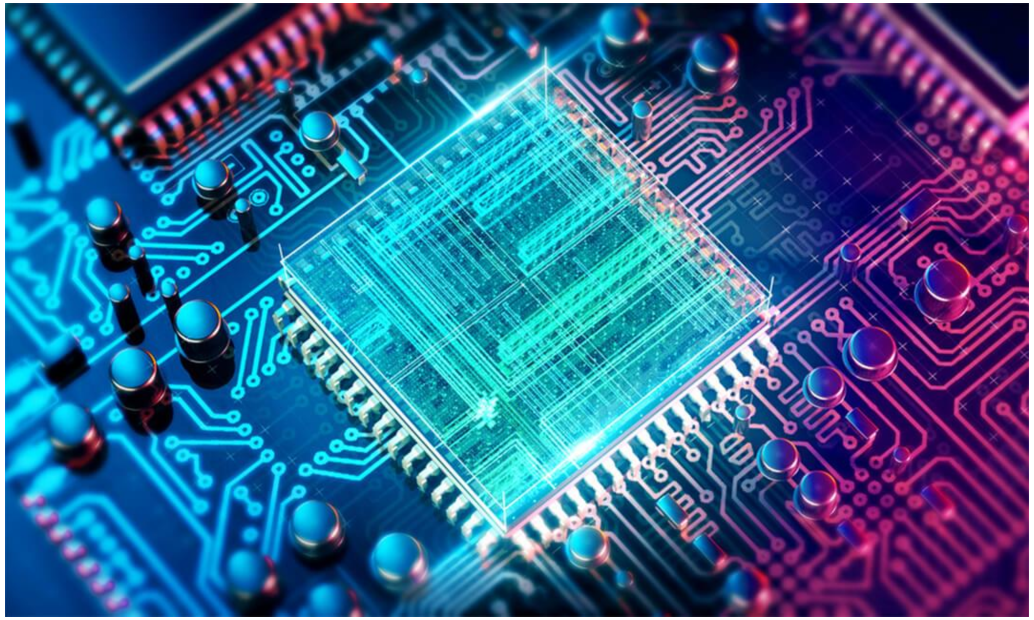
Digital System Design



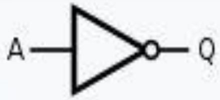
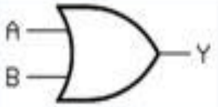
Logic Gates in detail

Logic Gates

- Basic Gates
- Buffer Gate
- Realization Of Gates
- Universal Gates
- Degenerative/Non-Degenerative Logic
- Special Output Gates

Basic Gate

There are 5 basic gates.

Digital gates	Symbol	Logic Operation	Mathematic Expression
BUFFER		Y = BUFFER A	Y = A
NOT		Y = NOT A	Y = $\bar{A}$
AND		Y = A AND B	Y = A . B
OR		Y = A OR B	Y = A + B
XOR		Y = A XOR B	Y = $A \oplus B$

AND

$A \cdot B$

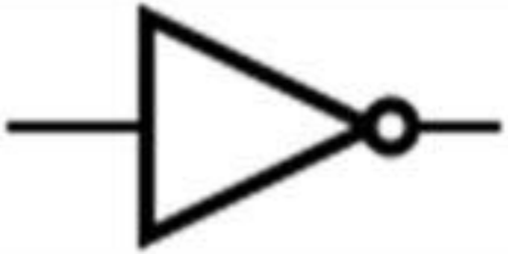
INPUT		OUTPUT
A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

OR

$A + B$

INPUT		OUTPUT
A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

NOT



$\overline{A}$

INPUT	OUTPUT
A	NOT A
0	1
1	0

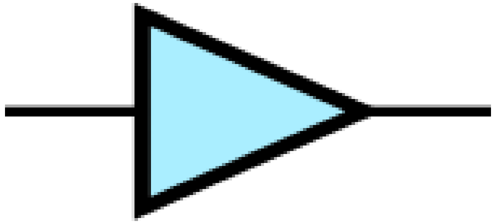
XOR

$A \oplus B$

INPUT		OUTPUT
A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

Buffer Gate

- Passes its input, unchanged, to its output.
- Used to increase the propagation delay of circuits.



Inputs	Outputs
A	Q
0	0
1	1

Realization Of Gates

- Realization of gates means solving a Boolean Algebraic equation and realize it using basic logic gates like AND,OR,NAND,NOR
- Word ‘realise’ here means to implement/represent an equation using logic gates
- Using universal gate we can implement AND gate, OR gate , NOT gate , EX-OR,EX-NOR etc

Universal Gates

- There are two universal gates
- 1 - NAND
- 2 - NOR
- All the Other Gates can be made from these gates
- Using NAND gate minimum number of gate require for :-

  NOT = 1

  AND = 2

  OR = 3

  EX-OR = 4

  EX-NOR = 5

- Using NOR gate minimum number of gate require for :-

  NOT = 1

  AND = 3

  OR = 2

  EX-OR = 5

  EX-NOR = 4

Degenerative Logic

- When two logic stage logic gate output can be expressed using a single logic gate then the logic function is called degenerative logic or degenerative function.
- .Using AND , OR , NAND , NOR total 16 combinational is possible:-
- 8 are degenerative logic

1 - (AND-AND) 2 - (OR-OR)

3 – (AND – NAND) 4 – (OR-NOR)

5 – (NAND-OR) 6 – (NAND-NOR)

7 – (NOR-NAND) 8 – (NOR-AND)

Non-degenerative Logic

- When two logic stage logic gate output cannot be expressed using a single logic gate then the logic function is called degenerative logic or degenerative function.
- 8 Non degenerative logic :-

1 – (AND-OR)

2 – (NOR-NAND)

3 – (AND-NAND)

4 – (NOR-AND)

5 – (NAND-OR)

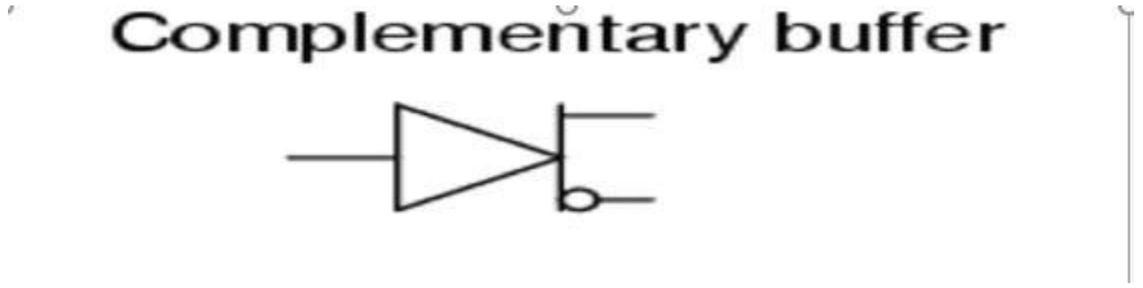
6 – (OR- NAND)

7 – (NAND-NOR)

8 – (OR-AND)

Special Output Gate

- A logic gate that provides both inverted and non-inverted outputs
- Such gates do exist and they are referred to as *complementary output* gates.
- Complementary gates are especially useful in “crowded” circuits
- For ex :-



Complementary AND gate

Complementary OR gate

Complementary XOR gate

THANK YOU