Date
20/09/21

Lecture - 4

LOGIC GATES

- Logic gates are fundamental building blocks of digital systems.
- The name 'logic gate' is derived from the ability of such a device to make decisions, in the sense that it produces one output level when some combination of input levels are present.
- 3 basic types of gates :-
  AND, OR and NOT
- Interconnection of gates to perform a variety of logical operations is called 'logic design'.
- Inputs and outputs of logic gates can occur only in two levels. These two levels are termed as 'HIGH' & 'LOW' or 'TRUE' & 'FALSE' or 'ON' & 'OFF' or '1' & '0'.
- A table which lists all the possible combination of input variables & the corresponding outputs is called a 'truth table'.
- We will use 'level logic', a logic in which the voltage levels represents logic 1 & logic 0. Level logic may be positive logic or negative logic.

+ve logic ⟶ higher of the two voltage levels represents the logic 1 & lower of the two voltage levels represents the logic 0.

-ve logic ⟶ lower of the two voltage levels represents the logic 1 & higher of the two voltage levels represent logic 0.

N.B. In transistor – transistor logic (TTL, the most widely used logic family), the voltage levels are +5V & 0V. In our syllabus, logic 1 corresponds to +5V & logic 0 to 0V.

AND Gate :-

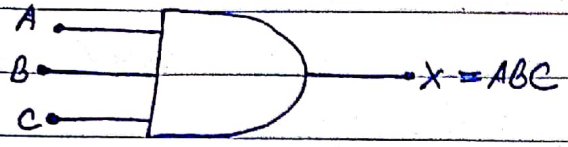
- An AND Gate has two or more inputs but only one output.
- The o/p assumes the logic 1 state only when each one of is I/Ps is at logic 1 state. The o/p assumes the logic 0 state if one of its i/ps is at logic 0 state.

Logic Symbol

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

← Truth Table

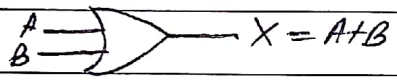
3 input AND gate :-



A	B	C	X = ABC
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

OR Gate :

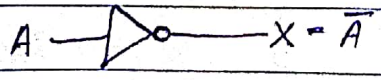
- Two or more inputs & only one output.
- The o/p assumes logic 1 state, if one of its input is in the logic 1 state. Its o/p assumes the logic 0 state when each of its inputs in the logic 0 state.



A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate (Inverter) :

- Has one i/p and one o/p.
- Device whose o/p is always the complement of its i/p



Truth table :-

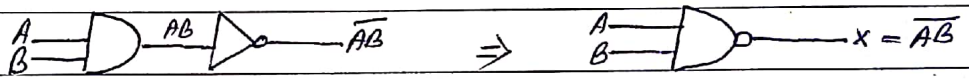
A	$B = \bar{A}$
0	1
1	0

The Universal Gates :-

2 types → NAND, NOR } Universal building blocks as they can realize logic ckts single handedly

NAND GATE :-

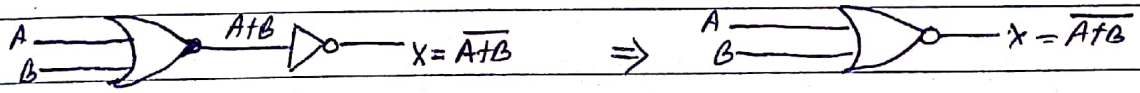
NAND means NOT AND i.e. the AND o/p is NOTed.



A	B	x
0	0	1
0	1	1
1	0	1
1	1	0

NOR Gate :-

NOR means NOT OR i.e. the OR o/p is NOTed.



A	B	x
0	0	1
0	1	0
1	0	0
1	1	0