1 EXPT NO. 2:

1.1 STUDY OF UNIVERSAL GATES

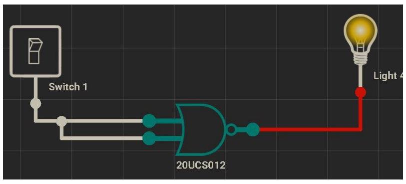
Objective:
To study NAND and NOR gates as universal Logic gates.

Equipments:
Logic Circuit Simulator Pro.

Theory
Circuit that can implement any Boolean function without need to use any logic gates. NAND and NOR are called universal gates. Basic gates form these gates.

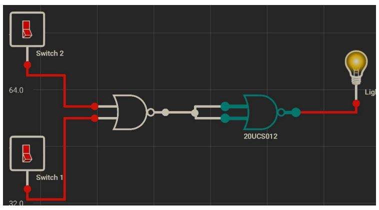
PROCEDURE:
1. Firstly, we have to install the LOGIC CIRCUIT SIMULATOR PRO APP and then after opening it we have to make a new project. 2. Then we have to add the required elements to make the circuits i.e LOGIC gates, inputs, outputs etc. 3. Then connect the elements together with the help of path to form a circuit and through the given gates we have to connect the input and output. 4. Lastly, we have to apply the TOUCH button to turn on/off the inputs i.e the switch by clicking on it, then we have to observe the output from output section. 5. Verify the truth table as per schematic and Gate which is constructed.

Realization of all basic gates using NOR gate:



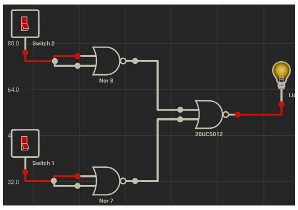
A	$\overline{A}$
0	1
1	0

Figure: NOT GATE



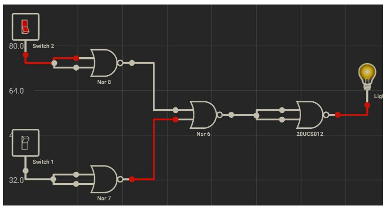
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

Figure: OR GATE



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

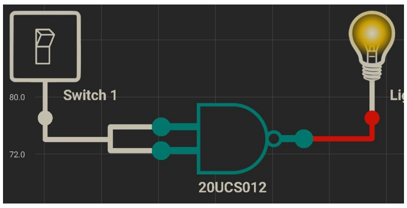
Figure: AND GATE



A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

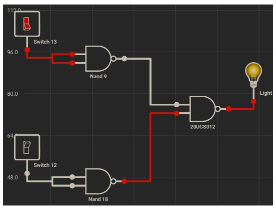
Figure: NAND GATE

Realization of all basic gates using NAND gate:



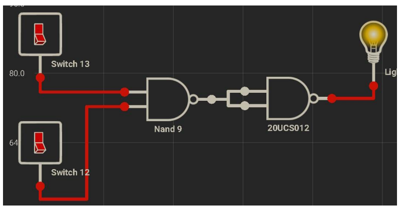
A	$\overline{A}$
0	1
1	0

Figure: NOT GATE



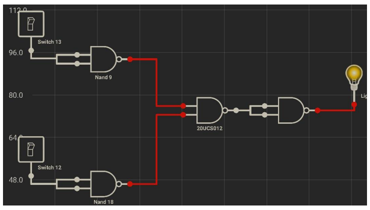
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

Figure: OR GATE



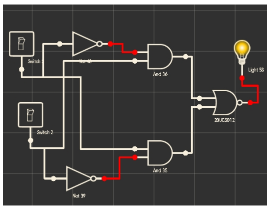
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

Figure: AND GATE



A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

Figure: NAND GATE



A	B	$\overline{A}.\overline{B}+A.B$
0	0	1
0	1	0
1	0	0
1	1	1

Figure: EXOR GATE

CONCLUSION:

The Truth tables for various digital gates like AND, OR, NAND, NOT, EX-OR, NOR are verified using universal gates.

2 EXPT NO. 3:

2.1 STUDY OF DE-MORGAN'S THEOREM

Objective:
To stduy and verify de-morgan's theorem.

Equipments:
Logic Circuit Simulator Pro.

Theory:
A mathematician named DeMorgan developed pair of rules regarding group complementation in Boolean algebra. By group complementation, represented by long bar over more than one variable. Inverting all inputs to a gate reverses that gate's essential function from AND to OR, or vice versa, and also inverts the output. So, an OR gate with all input inverted (a negative OR gate) behave the same as NAND gate and an AND gate with all inputs inverted (a negative AND gate) behave the same as a NOR gate. This theorems state the same equivalence in "backward" from: that inverting the output of any gate results in the same function as the opposite type of gate (AND vs OR) with inverted inputs.

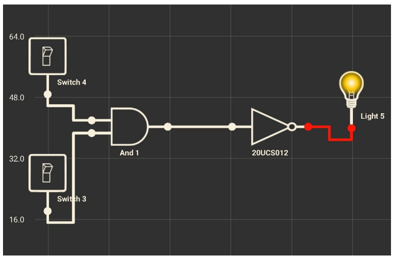


Figure 1: This gate

is equivalent to

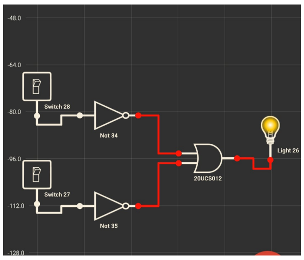


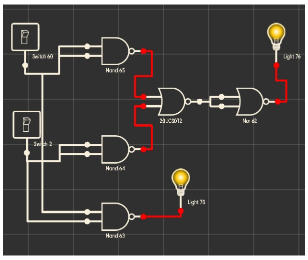
Figure 2: This gate

PROCEDURE

Verification of DeMorgan's theorem

- **Theorem 1 : (AB)' = A' + B'**

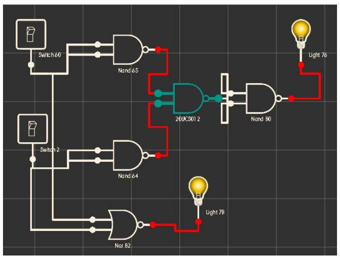
  1. The respective components are added first by pressing add buttons.
  2. Then, 2 switches, many nodes, many gates are added for each gate (Except, the NOT gate, in this only one switch is added).
  3. A light bulb is added for output purpose.
  4. Connect switches with wires to the gates and connect the gate to the light bulb via the wire.
  5. Observe the output and from this we can verify the De-Morgans theorem. Calculate the gate count and chip count before and after applying.



A	B	$\overline{A.B}$	$\overline{A}$	$\overline{B}$	$\overline{A}+\overline{B}$
0	0	1	1	1	1
0	1	1	1	0	1
1	0	1	0	1	1
1	1	0	0	0	0

- **Theorem 2: (A+B)' = A'B'**

  1. Repeat above procedure for above rule.



A	B	$\overline{A+B}$	$\overline{A}$	$\overline{B}$	$\overline{A}.\overline{B}$
0	0	1	1	1	1
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	0

CONCLUSION:

The study of DE MORGAN'S THEOREM is verified using various digital gates.