Aim - To realize the gates using universal gates.

Objective -

- To study the realization of basic gates using universal gates.
- Understanding how to construct any combinational logic function using NAND or NOR gates only.

Theory -

AND, OR, NOT are called basic gates as their logical operation cannot be simplified further.
NAND and NOR are called universal gates as using only NAND or only NOR, any logic function can be implemented.

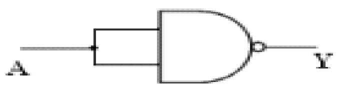
Components required -

1. IC's 7400(NAND) 7402(NOR)
2. Bread Board.
3. Connecting wires.

Circuit Diagram -

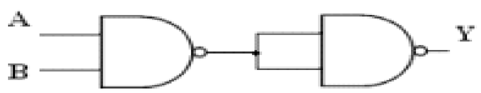
Implementation using NAND gate:

(a) NOT gate: $Y = A'$



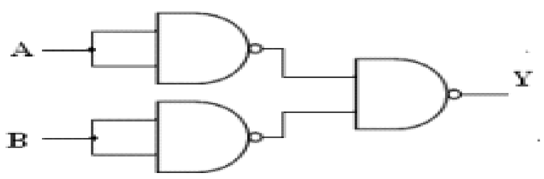
A	Y
0	1
1	0

(b) AND gate: $Y = A \cdot B$



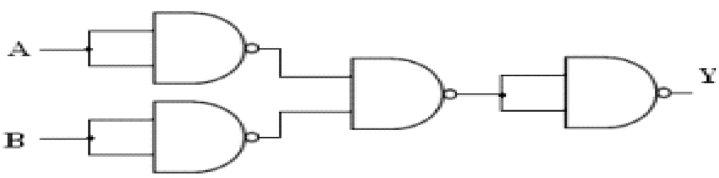
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(c) OR gate: $Y = A + B$



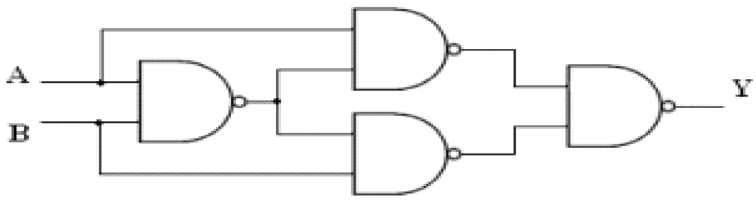
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(d) NOR gate: $Y = (A + B)'$



A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

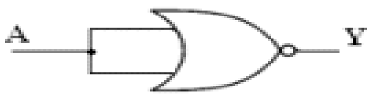
(e) Ex-OR gate: $Y = A \oplus B$



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

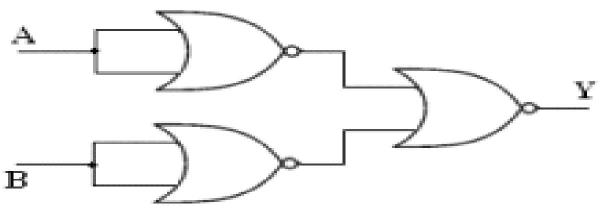
Implementation using NOR gate:

(a) NOT gate: $Y = A'$



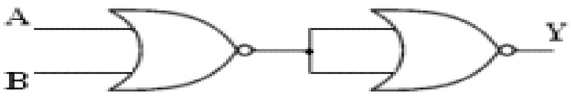
A	Y
0	1
1	0

(b) AND gate: $Y = A \cdot B$



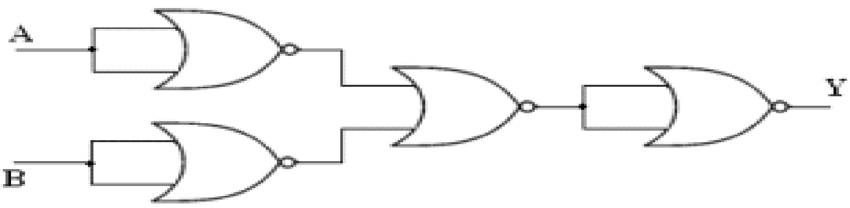
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(c) OR gate: $Y = A + B$



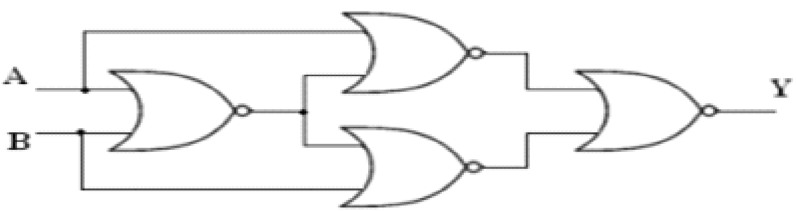
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(d) NAND gate: $Y = (AB)'$



A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(e) Ex-NOR gate: $Y = A \odot B = (A \oplus B)'$



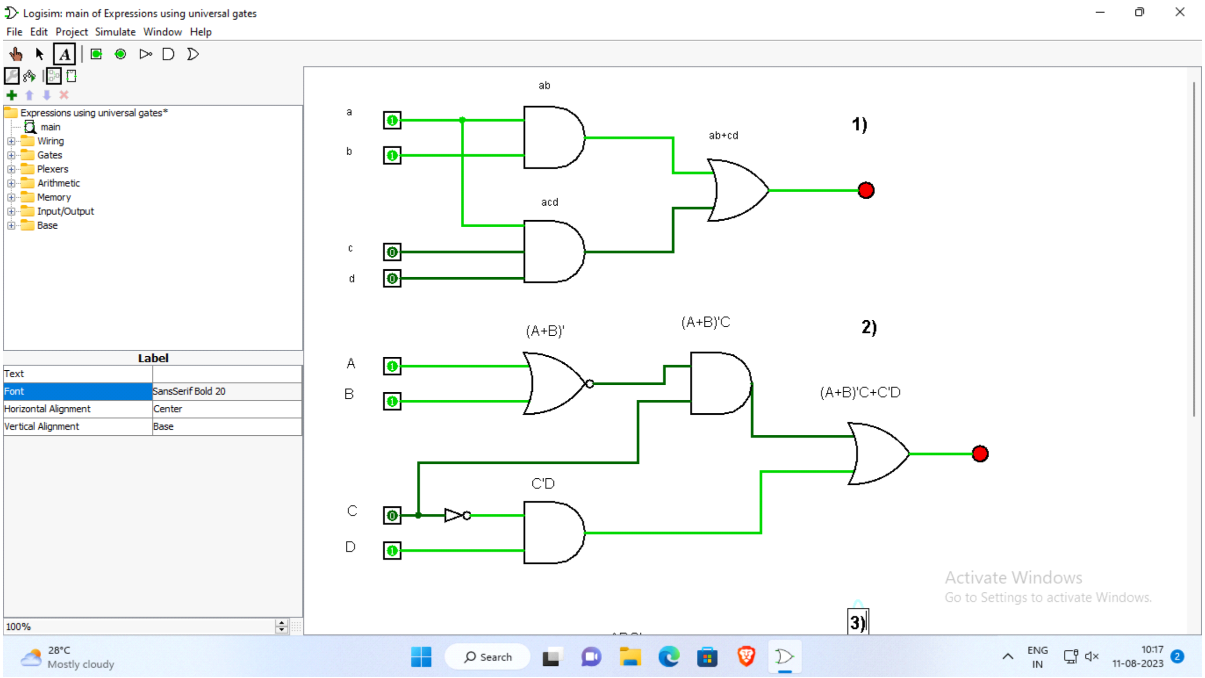
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

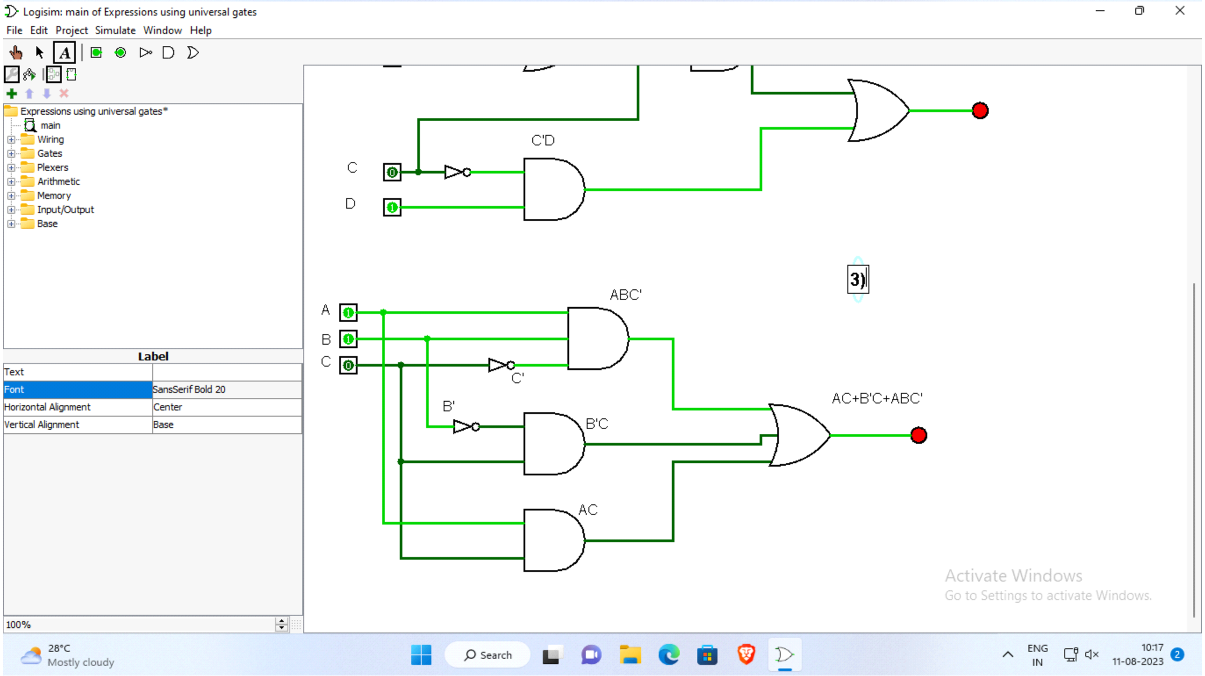
Procedure:

a) Connections are made as per the circuit diagrams.

b) By applying the inputs, the outputs are observed and the operations are verified with the help of truth table.

Output:-





Conclusion – Realizing logic gates using universal gates is a fundamental concept in digital electronics. This approach highlights the versatility and efficiency of universal gates in simplifying circuit designs. In conclusion, the utilization of universal gates, such as NAND and NOR gates, allows for the implementation of all other logic gates, including AND, OR, and NOT gates. This concept emphasizes the economy of scale, as a single type of gate can replace multiple gate types, reducing the complexity of circuitry and potentially saving on hardware costs.

Furthermore, this approach encourages creative problem-solving and logical thinking, as it requires users to think critically about how to combine universal gates to perform specific logic functions. It also promotes resource optimization in integrated circuit design, as universal gates can be more readily available and cost-effective. In conclusion, understanding and applying universal gates in digital circuit design is an essential skill for engineers and electronics enthusiasts, as it not only simplifies complex circuits but also demonstrates the underlying principles of Boolean algebra in a practical and efficient manner.