Name of Experiment: Implementation of Full Subtractor.

Objective: - To understand the design and implementation of a full subtractor using logic gates and verify the truth table.

Apparatus required:-The following electronics components are required.
- AND Gate (IC-7408)
- OR Gate (IC-7432)
- NOT Gate(IC-7404)
- XOR Gate (IC-7486)
- Digital IC Trainer KIT
- Breadboard
- Connecting wires

Description:-
A combinational circuit which performs the subtraction of three input bits is called full subtractor. The three input bits include two significant bits and a previous borrow bit. A full subtractor circuit can be implemented with two half subtractors and one OR gate. It has three inputs, A (minuend) and B (subtrahend) and BOR_{in} (subtrahend) and two outputs D (difference) and BOR_{out}(borrow).

Logic Circuit:-
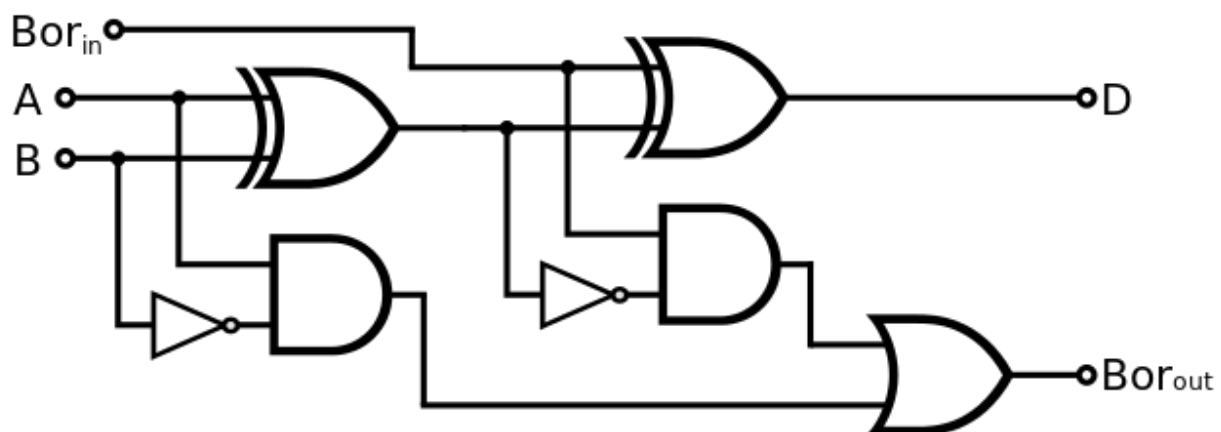
Truth-table:-

Input			Output	
A	**B**	**B$_{in}$**	**D**	**B$_{out}$**
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Boolean Expression: -

If inputs are A, B and BOR$_{in}$ then expression of full subtractor then the expression will be -

$$D = A \oplus B \oplus BOR_{in}$$
$$BOR_{out} = BOR_{in}.\overline{(A \oplus B)} + \overline{A}.B$$

Procedure to Perform:-

❖ Take Digital Trainer KIT with IC-7408, 7486, 7404, 7432 and connecting leads.
❖ Insert four ICs on the Breadboard.
❖ According to pin configuration of IC perform the connections.
❖ Connect Vcc(+5V) to pin no-14 and Connect Pin no-7 to GND of three ICs.
❖ Connect the XOR Gate input connection to the input switched D0 and D1 to the Digital Trainer KIT (Inputs are pin no (1,2),(4,5),(8,9),(11,12) and Outputs are pin no 3, 6, 10, 13).
❖ Connect the XOR output with input switched D2 through another XOR gate.
❖ Connect the output of last XOR gate to output LED.
❖ Connect first XOR output with NOT gate and connect its output with D2 through AND gate(Inputs are pin no (1,2),(4,5),(8,9),(11,12) and Outputs are pin no 3, 6, 10, 13).
❖ Connect input D0 with a NOT gate and connect its output with D1 through AND gate.
❖ Connect this & previous AND gate output to a OR gate. (Inputs are pin no (1,2),(4,5),(8,9),(11,12) and Outputs are pin no 3, 6, 10, 13)

❖ Connect the OR gate output with an output LED.

❖ Switch On the Digital IC Trainer KIT.

❖ Apply the various combination of Truth table and verify the output at LED's.

❖ If output LED glows RED it shows logic HIGH or 1.

❖ If output LED glows GREEN it shows logic LOW or 0.

❖ Switch off the Digital Trainer KIT after performing the Experiment.

❖ Disconnect Output from the LED and note down the corresponding multi-meter voltage reading for various combinations of inputs (not required).

Conclusion: - All the output is verified according to the result of the truth table.

Precaution in lab:-

•All the connections should be tight and proper.

•Handle the ICs carefully.

•Check the connection once again before Switching on the Digital Trainer KIT.

•Switch off the Trainer Kit after performing the Experiment.