**Theory:**

**Logic gates:** Logic gates are the components which are used to design a logical circuit or digital circuit. These logic gates are used to perform logical operations from logical inputs to get a single logical output. Logic gates only consider two discrete values of voltage level to determine the inputs. Those values also can called binary inputs. The binary value 1 is to represent logical high or True and the value 0 is to represent the logical low or false. Logic gates are named as AND, OR, NOT, NAND, NOR, XOR to perform logical operations and design digital circuit.

**Truth Table:** A truth table is a binary input-output table, used to represent the corresponding outputs by a function using logic gates. It describes the relationship between the input and output of a logic circuit. For each and every possible combination of inputs, a truth table show all possible outputs.

**Boolean algebra:** Boolean algebra is used to analyze and simplify the digital (logic) circuits. It uses only the binary numbers 0 and 1. It is also called as Binary Algebra or logical Algebra. Digital circuits are expressed with Boolean algebra. A set of axioms and theorems are used to simplify Boolean equations.

**Combinational Logic:** It is a kind of digital logic which is implemented by Boolean circuits. Here the output is dependent on the present inputs and is not affected by previous state. For analyzing, it requires writing the Boolean functions for each element of the circuit, producing their truth tables, and subsequently combining each function for the final output and truth table.

**Integrated Circuit (IC):** This is an electronic circuit formed by small piece of semiconducting material. In Digital logic design, we use Integrated circuits of 7400 series. These IC’s contains various types of gates. For example, 7408 IC contains 4 AND gates where, 7404 IC contains 6 NOT gates. All of these gates have 14 pins. Among these pins the 7th pin is designed to connect to the ground and the 14th pin is designed to connect to +5V as Vcc.

**Discussion:**

In Lab01, we did 2 experiments to understand digital logic gates and Boolean functions. In the First Experiment, our goal was to learn about the basic characteristics of the AND, OR, XOR, NAND, NOT & NOR GATES and how to build the gates using Logisim. Then we know how to use to gates to simulate a circuit diagram. Then comes the first experiment simulation part, we deigned different IC of the gates and implement the position number of output and input pin correctly. Then we draw the truth table and our circuit output truth table matched with it. So, after that we can say that our circuit are working properly.

And then we did our second experiment in which our objective was to proof associative law by constructing a 3-input AND gate or OR gate from 2-input AND or OR gates. So, we draw our desire circuit for experiment 2. The circuit output truth table matched with our truth table. So, after analyzing this truth table we got to know that the associative law is same for both practical simulation and theoretical proof. Then we were simulated 6-input AND gate in Logisim using only 2-input AND gates.

After doing these two experiments, I know how to use Logisim and its functions and have a basic idea of logic gates and truth table. Also know about Boolean function and associative law.

**Questions**

E.1.2 Questions:

1) What are the names of the ICs that you would need if you wanted to use 13 AND gates, 12 NOT gates and 15 NOR gates in a circuit? How many of each IC would you need?

Ans: For 13 AND gates, I would need 4 7408 ICs. Each 7408 IC contains 4 AND gates. Therefore, we need ⌈13/4⌉ = 4 ICs.

For 12 NOT gates, I would need 2 7404 ICs. Each 7404 IC contains 6 NOT gates. Therefore, we need 12/6 = 2 ICs.

For 15 NOR gates, I would need 4 7402 ICs. Each 7402 IC contains 4 NOR gates. Therefore, we need ⌈15/4⌉= 4 ICs.

2) How can you power your logic ICs if the +5V port of your trainer board stops working?

Ans: logic IC can be powered directly by connecting its +5V port to DC power supply in case the +5V port of the trainer board stops working.

E.3.2 Questions:

1) Draw the IC diagram for the first implicant I1. In place of the logic gates, draw the ICs and all the connections required to make the circuit work.

