

**L D COLLEGE OF ENGINEERING  
ELECTRONICS AND COMMUNICATION  
DEPARTMENT**

**LABORATORY MANUAL  
FOR  
DIGITAL ELECTRONICS  
(2131004)  
B.E III SEMESTER**

**SUBJECT CO ORDINATOR: KINJAL RAVI SHETH**

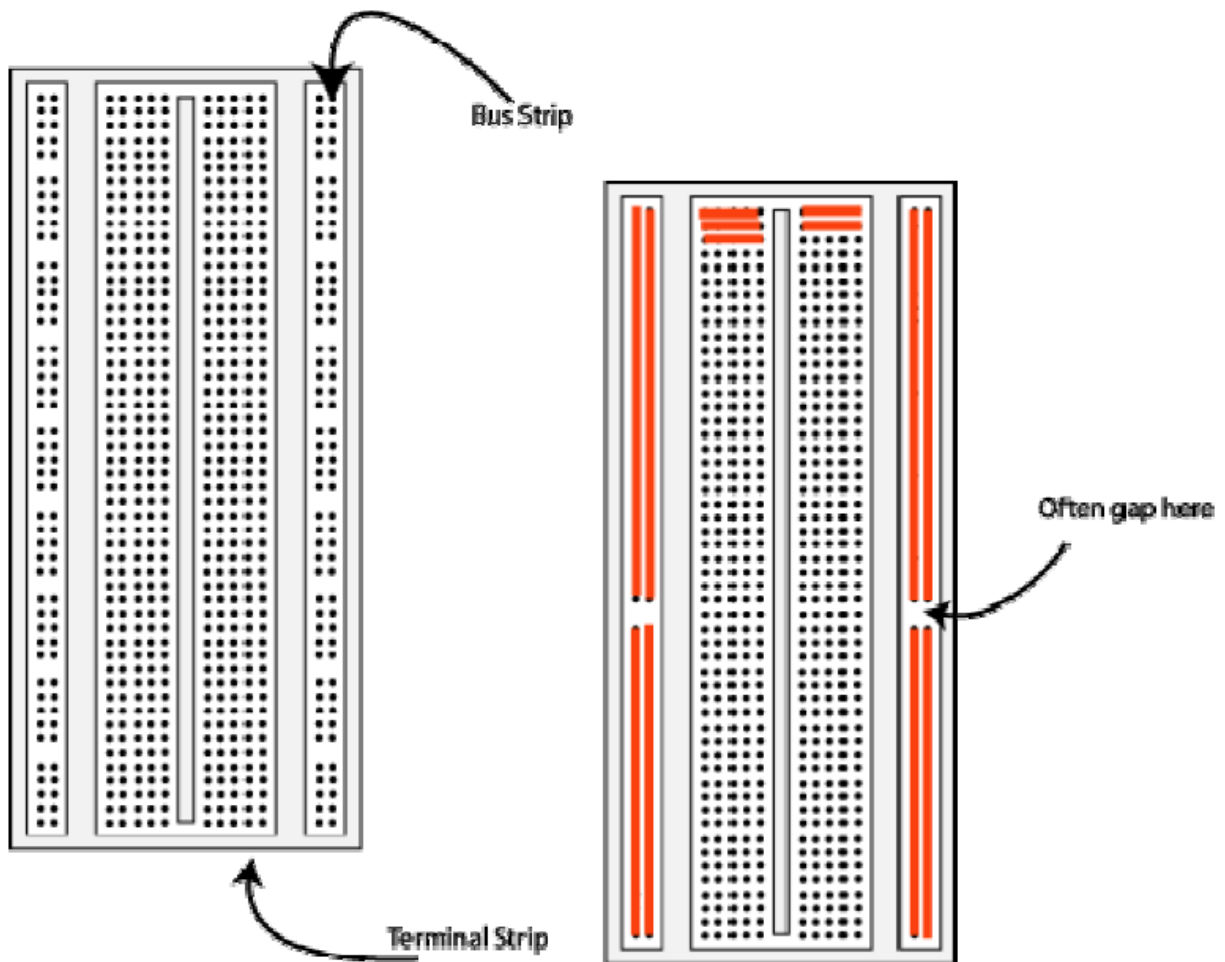
<b>DO'S</b>	<b>DON'TS</b>
1. Be regular to Lab.	<ul style="list-style-type: none"> <li>• Don't exceed the voltage rating.</li> </ul>
2. Maintain Silence	<ul style="list-style-type: none"> <li>• Do not interchange the IC's while doing the experiment.</li> </ul>
3. Know the theory behind experiments before coming to the lab.	<ul style="list-style-type: none"> <li>• Avoid loose connection and short circuits.</li> </ul>
4. Identify different terminals or leads or pins of the IC's before making connection.	<ul style="list-style-type: none"> <li>• Do not throw the connecting wires to floors.</li> </ul>
5. Know the biasing voltage required for different families of IC's and connect the power supply voltage and ground terminals to the respective pins of the IC's.	<ul style="list-style-type: none"> <li>• Do not panic if you don't get the output.</li> </ul>
6. Know the current and voltage rating of the IC's before using them.	
7. Handle the IC trainer kit properly.	
8. Avoid unnecessary talking while doing experiment.	
9. After completion of the experiments switch off the power supply and return the apparatus.	
10. Arrange the chairs/stools and equipment properly before leaving the lab.	

<b>No.</b>	<b>Title of Experiment</b>
<b>1</b>	[A] Realization Of Gates Using Discrete Components [B] Realization Of Gates Using Integrated Circuits
<b>2</b>	[A] Realization Of Basic Gates Using Universal Gate.
<b>3</b>	

## BREADBOARD

The breadboard consists of two terminal strips and two bus strips (often broken in the centre). Each bus strip has two rows of contacts. Each of the two rows of contacts is a node. That is, each contact along a row on a bus strip is connected together (inside the breadboard). Bus strips are used primarily for power supply connections, but are also used for any node requiring a large number of connections. Each terminal strip has 60 rows and 5 columns of contacts on each side of the centre gap. Each row of 5 contacts is a node.

You will build your circuits on the terminal strips by inserting the leads of circuit components into the contact receptacles and making connections with 22-26 gauge wire. There are wire cutter/strippers and a spool of wire in the lab. It is a good practice to wire +5V and 0V power supply connections to separate bus strips.



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The 5V supply **MUST NOT BE EXCEEDED** since this will damage the ICs (Integrated circuits) used during the experiments. Incorrect connection of power to the ICs could result in them exploding or becoming very hot - with the **possible serious injury occurring to the**

**people working on the experiment! Ensure that the power supply polarity and all components and connections are correct before switching on power.**

## EXPERIMENT 1

### [A] REALIZATION OF GATES USING DISCRETE COMPONENTS

### [B] REALIZATION OF GATES USING INTEGRATED CIRCUITS

#### **Learning Outcome:**

After performing this experiment, students will be familiar with various digital integrated circuits of different logic families. They will be able to understand the data sheet of these circuits/ICs.

**Aim:** To construct logic gates **OR, AND, NOT, NOR, NAND** gates using discrete components and verify their truth tables. To realize the logic gates using ICs and verify the truth tables.

#### **Apparatus:**

1. Breadboard
2. Resistors 10k, 1k, 220ohms
3. Transistors 2N2222 (NPN)
4. Diodes 1N 4001
5. AND Gate IC 7408
6. OR Gate IC 7432
7. NOT Gate IC 7404
8. NAND Gate IC 7400
9. NOR Gate IC 7402
10. Connecting wires
11. DMM
12. LEDs

#### **Theory:**

##### **1. OR Gate:**

The operation of these gates is to consider the diode as a simple switch, which is closed (on) when the voltage on one side (the anode) is higher than the other (the cathode). The current then flows in the direction of the arrow in the diode's circuit diagram symbol. The figure 1(a) shows the logic symbol, my discrete component implementation, and the truth table. In an OR gate, the output is "1" (high) if either of the inputs are "1". In this diagram, if either of the inputs has a "high" voltage, its diode will conduct and current will flow to the output. A "high" voltage will develop across the resistor, equivalent to the input voltage minus 0.7V drop, as is usual across silicon diode junctions. If both of the inputs are low voltage "0", then the diodes don't conduct. In this instance the gate's output is tied low by the 10K resistor.

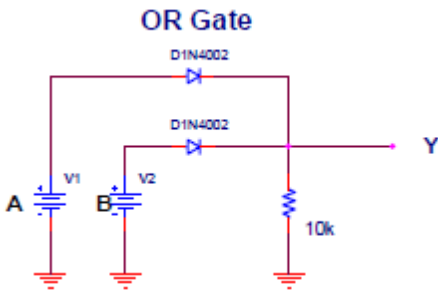
## AND Gate:

It's similar to the OR gate except that the diodes point in the other direction, and the resistor goes to +5V not ground. The output of an AND gate is "1" only if BOTH the inputs are "1". In diode-resistor implementation, if either input is "low" voltage (logic "0") then the diode will conduct and the output is effectively shorted to ground. If both of the input voltages are "high" (logic "1") then neither of the diodes will conduct, so the output is not shorted to ground: it remains at +5V (logic "1") via the 10K resistor. This gives the desired result. Note that again, due to the silicon junction voltage, the actual "low" output voltage is 0.7V higher than the "low" input voltage.

## NOT Gate:

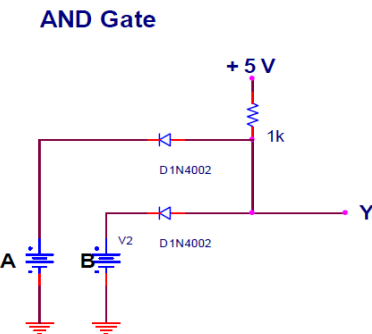
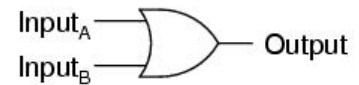
You cannot implement an inverting function with diodes and resistors alone. You also now need a transistor, to provide the inverting action. There's nothing particularly special about the transistor to be used, almost any small signal NPN transistor will suit, since it's driven into saturation (unbiased). If the voltage presented to the base of the transistor is above 0.7, the transistor will conduct which drags the output to logic "0", low voltage. If the input voltage is logic "0", then the transistor does not conduct, and the resistor will just tie the output to +5V. You always need that 10K current limiting resistor in the base, or excessive base-emitter current will destroy the transistor.

## Circuit Diagrams:



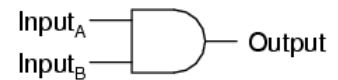
A	B	Y
0v	0v	0v
0v	5v	5v
5v	0v	5v
5v	5v	5v

2-input OR gate

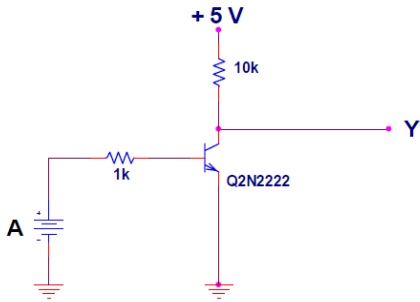


A	B	Y
0v	0v	0v
0v	5v	0v
5v	0v	0v
5v	5v	5v

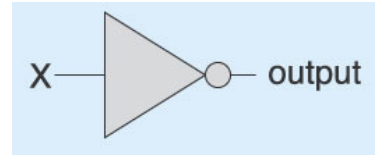
2-input AND gate



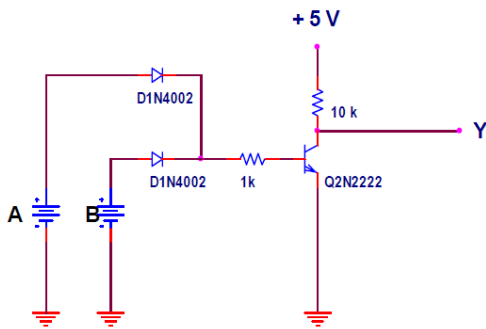
**NOT Gate**



A	Y
0v	5v
5v	0v

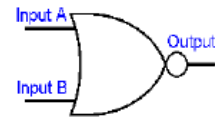


**NOR Gate**

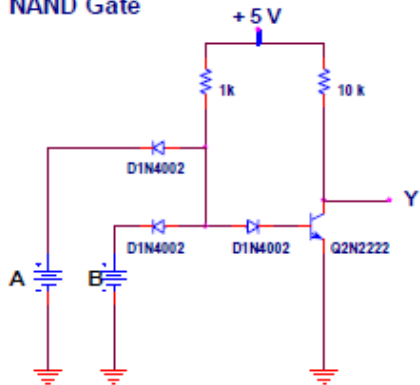


A	B	Y
0v	0v	5v
0v	5v	0v
5v	0v	0v
5v	5v	0v

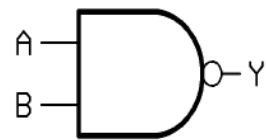
**2-input NOR gate**



**NAND Gate**

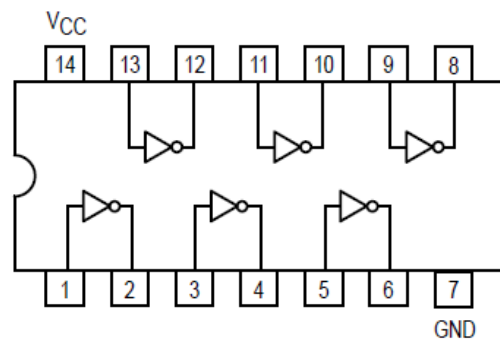
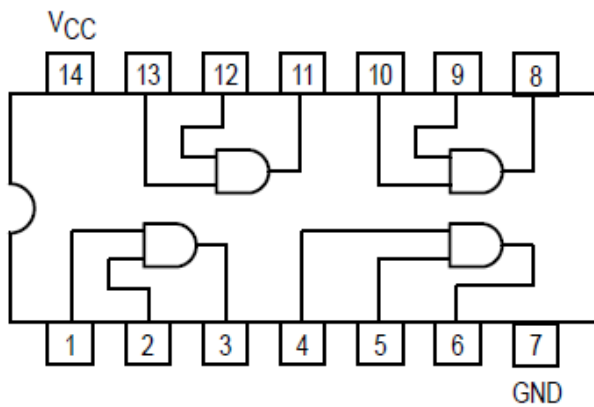


A	B	Y
0v	0v	5v
0v	5v	5v
5v	0v	5v
5v	5v	0v

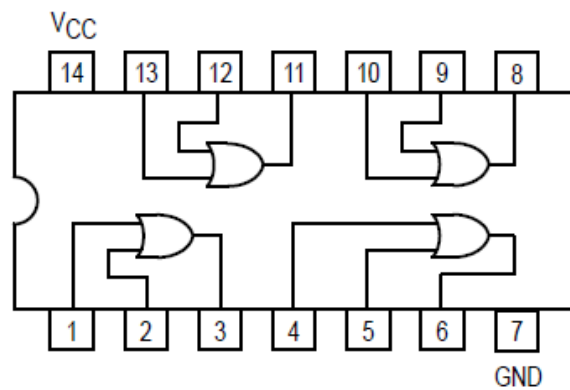
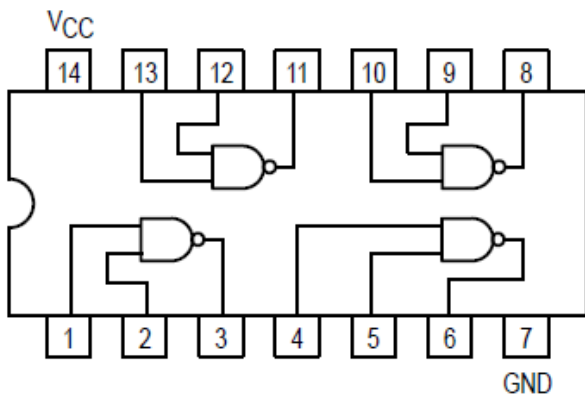


**Fig: 1: logic gate symbol, discrete components implementation and truth table**





7432



**Fig: 2: Pin Configuration (a) AND Gate IC7408 (b) NOT Gate IC7404 (c) NAND Gate IC7400 (d) OR Gate IC**

### **Procedure:**

#### **[A] REALIZATION OF GATES USING DISCRETE COMPONENTS**

1. Connections are made as per the circuit diagram.
2. Switch on the power supply.
3. Apply different combinations of inputs and observe the outputs; compare the outputs with the truth tables.

#### **[B] REALIZATION OF GATES USING INTEGRATED CIRCUITS**

1. Place the IC on breadboard.
2. Connect Vcc and Gnd to the respective pins of IC Trainer Kit.
3. Connect the inputs to the input switches/logical switches.
4. Connect the output to the switches of O/p or LEDs.
5. Apply various combinations of inputs according to the truth table and observe condition of LEDs.

6. Disconnect output from LEDs and note down the corresponding multimeter voltage readings for various combinations of inputs.

**Precautions:**

All the connections should be made properly.

**Result:**

Different logic gates are constructed and their truth tables are verified.

**Conclusion:****Assignment:**

1. Realize the XOR and XNOR gate using Discrete components.
2. Verify the Truth Table of XNOR gate using IC. Search out the web for Datasheet of IC7402 and IC 7432.

## EXPERIMENT 2

### **[A] REALIZATION OF BASIC GATES USING UNIVERSAL GATE.**

#### **Learning Outcome:**

After performing this experiment student will be able to learn and design the basic logic gates using Universal Gates NAND and NOR. Student will be able to design or realize the Boolean expression using AOI Logic (AND/OR/NOT gates) as well as Universal Gates.

**Aim:** To Implement Boolean expression using AOI logic. To design basic gates using NAND gate.

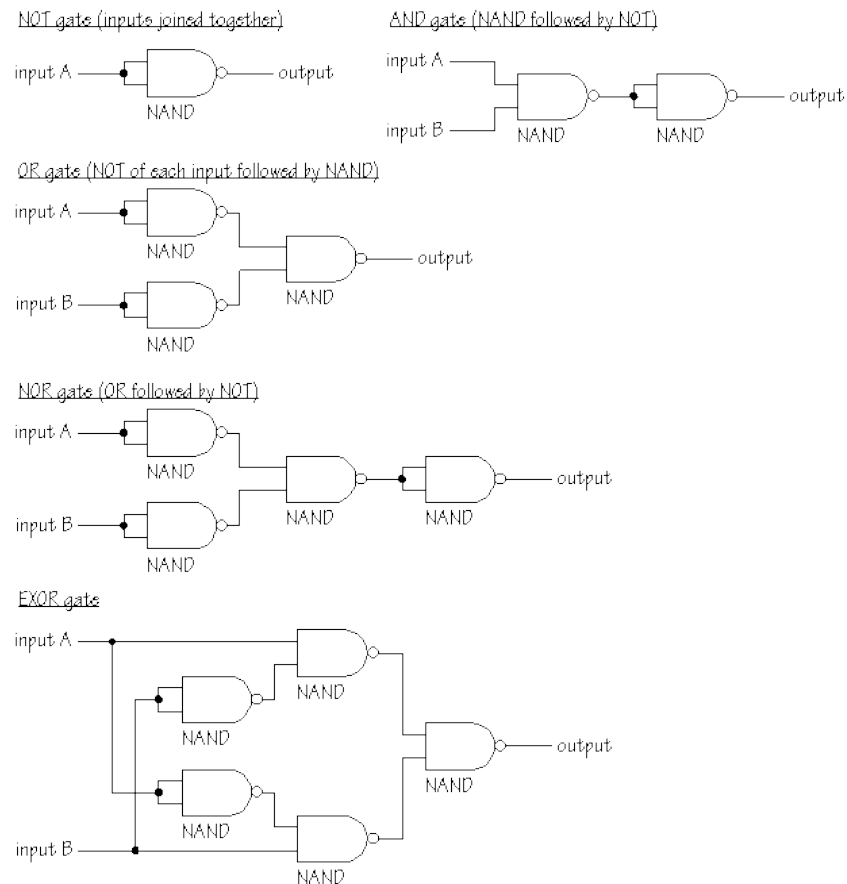
#### **Apparatus:**

1. Breadboard
2. NAND Gate IC 7400
3. NOR Gate IC 7402
4. Connecting wires
5. DMM
6. LEDs
7. Power Supply

#### **Theory:**

A binary variable can take the value of 0 or 1. A Boolean function is an expression formed with binary variables, the two binary operators OR and AND, and unary operator NOT, parentheses, and an equal sign. For a given value of the variables, the function can be either 0 or 1. Boolean function represented as an algebraic expression may be transformed from an algebraic expression into a logic diagram composed of AND, OR, and NOT gates. . Every Boolean function can be realized by a And-Or-Not gates i.e. using AOI logic.

NAND GATE is a universal gate. It is so called as because by using of this gate we can make any gate like not, or, and etc. by help of this gate we can also make multiplexers and de mux.



**Fig. 1: Implementation of Basic Gates Using NAND Gate**

**Procedure:**

1. Place the IC on breadboard.
2. Connect Vcc and Gnd to the respective pins of IC Trainer Kit.
3. Connect the inputs to the input switches/logical switches.
4. Connect the output to the switches of O/p or LEDs.
5. Apply various combinations of inputs according to the truth table and observe condition of LEDs.
6. Disconnect output from LEDs and note down the corresponding multimeter voltage readings for various combinations of inputs.

**Precautions:**

1. All the connections should be made properly.
2. Before the circuit connection it should be checked out working condition of all the components and ICs.

**Result:**

Different logic gates are constructed and their truth tables are verified.

## Conclusion:

## Questions:

1. Realize the basic gates using NOR gate.
2. Realize the following function using basic Logic Gates and Universal NAND gate.  
 $f = B(A+CD)+AC'$

## EXPERIMENT 2

### DESIGN OF COMBINATIONAL LOGIC CIRCUITS

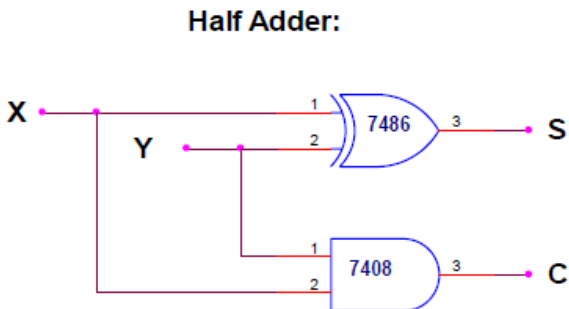
**Aim:** To design and construct Half-adder, Full-adder.

**Apparatus:**

1. Breadboard
2. Resistors 10k, 1k, 220ohms
3. IC's - 7486, 7432, 7408, 7400
4. Connecting wires

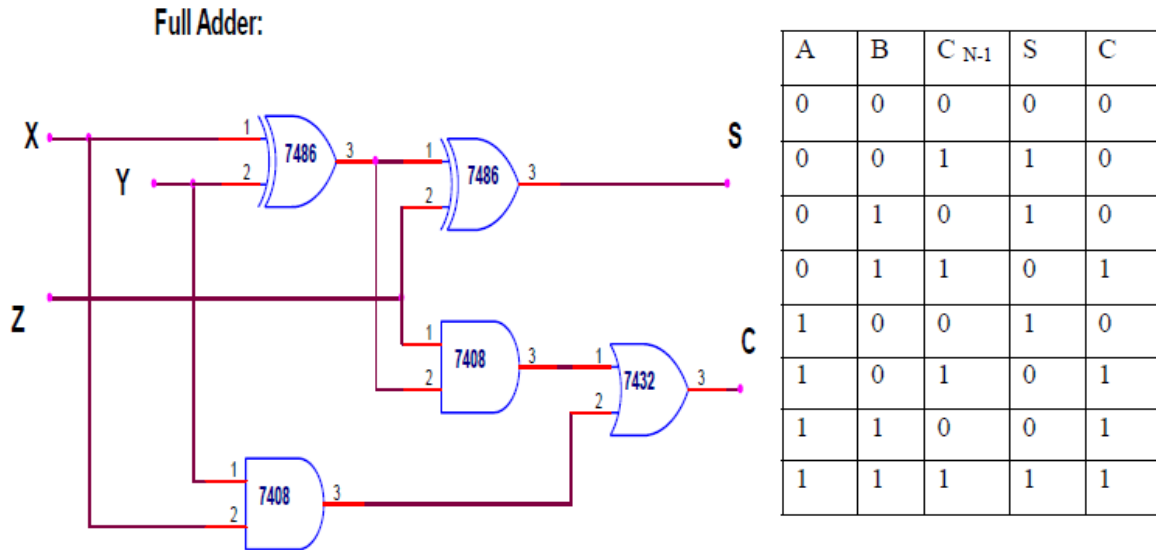
**Theory:**

#### Circuit Diagrams



#### Truth Table

A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1



**Fig: 1: logic gate symbol, discrete components implementation and truth table**

**Procedure:**

1. Verify the gates.
2. Make the connections as per the circuit diagram.
3. Switch on Vcc and apply various combinations of input according to truth table.
4. Note down the output readings for half/full adder and half/full subtractor, Sum/difference and the carry/borrow bit for different combinations of inputs verify their truth tables.

**Precautions:**

1. All the connections should be made properly.
2. IC should not be reversed.

**Result:**

Combinational logic circuits like Half-adder, Full-adder are constructed and truth tables are verified.

**Questions:**

1. Describe the difference between half-adder and full-adder.
2. Design and construct Half-subtractor and full-subtractor.