

EXPERIMENT No. 1
FAMILIARIZATION OF BENCH EQUIPMENTS AND SIMPLE LOGIC CIRCUIT IMPLEMENTATION.

Learning Outcomes

1. Familiarity with IC tester, Power Supply, Bread Board.
2. Familiarize with digital IC data sheets
3. Familiarization with working and applications of basic logic gates.
4. Designing a circuit from truth table using SOP form of equation.

Equipments and components Required

Analog/Digital IC tester, Power Supply, Bread Board, LED Panel, Panel of toggle switches.

7408 – Quad 2-input AND
7486 – Quad 2-input XOR

7432 – Quad 2-input OR
7404 – Quad 2-input NOT

PRECAUTIONS:

Following things will cause wrong /improper behavior of assembled circuit.

1. Not connecting the ground and/or power pins for all chips.
2. Not turning on the power supply before checking the operation of the circuit.
3. Leaving out wires.
4. Plugging wires into the wrong holes of breadboard.
5. Modifying the circuit with the power on.
6. All of the gate outputs are not correct for the levels present at their inputs.

Run #01: Integrated Circuits (ICs)

An IC is an abbreviation for a monolithic Integrated circuit also known as (microchip, Si chip, computer chip or chip) is a miniaturized electronic circuit (consisting mainly of semiconductor devices as well as passive components) which has been manufactured in the surface of a thin substrate of semiconductor material.

Based on functionality/use IC can be categorized as Analog or Digital IC.

Digital ICs can be categorized based on their sizes as SSI, MSI, LSI, VLSI.

- Small scale integration (SSI)—3 to 30 gates/chip.
- Medium scale integration (MSI)—30 to 300 gates/chip.
- Large scale integration (LSI)—300 to 3,000 gates/chip.
- Very large scale integration (VLSI)—more than 3,000 gates/chip.

Based upon the active devices employed in the IC, Digital ICs can be classified as BIPOLAR (using bipolar active devices like BJT) and UNIPOLAR (using unipolar active devices like FET).

In general ICs of TTL (74XXX Series) and high speed CMOS (4XXX series) families are used in digital Lab. TTL ICs uses BJT as an active device while CMOS ICs uses FET as an active device.

Q:1.1

(a) Part number of the given IC = _____?

- (b) Whether given IC belongs to TTL / CMOS family = _____?
- (c) Total no. of pins of the IC = _____?

Run # 02: Familiarization with IC data sheets

Q:1.2

An IC (Integrated Circuit) 7432 is given to you. Refer its datasheet to give following details:

- (a) Typical Supply Voltage rating:
- (b) Operating Temperature Range:
- (c) Package type:
- (d) How to identify Pin.no.1 of the IC?
- (e) Pin No. _____ of IC should be used to connect VCC.
- (f) Pin No. _____ of IC should be used to connect GND.
- (g) Logic function of the given IC is _____.
- (h) Total _____ no. of _____ gates are employed in the IC. Are they independent of each other (Y/N) _____?
- (i) Each logic gate of the IC should be provided _____ no. of inputs.
- (j) Fill up following table 1.1 to enlist input pin nos and corresponding output pin for each of the logic gate of the IC.

Logic Gate No.(x)	Input Pin numbers(Ax,Bx) of IC	Output Pin number of IC for corresponding logic gate (C)
1		
2		
3		
4		

Table 1.1

- (k) Whether given IC operates with POSITIVE / NEGATIVE LOGIC?
- (l) Logic of 7408 IC is _____.
- (m) Logic of 7486 IC is _____.
- (n) Logic of 7404 IC is _____.

Run # 03: IC tester

It is an instrument which can test the functionality of Analog as well as digital ICs.

Q: 1.3 Observe front panel of IC tester. Which type of Display is used?

Q: 1.4 Enlist different functions supported by the IC tester?

Use IC tester to test your ICs before use for the further expt.

Run # 04: DC Power Supply

The power supply is a source of regulated DC power. It is used to power different ICs. It is also used to provide logic level inputs to different digital circuits.

Q: 1.5 Observe front panel of the equipment. Note down different voltage ranges of DC power supply.

Q: 1.6 Which voltage range would you choose for digital IC based experiments?

Run # 05: Bread-Board

The bread-board is a general purpose board which can be used to test and carry out experiments with analog as well as digital circuits.

Figure 1.1 shows a typical bread board layout, consists of two types of region also called strips. Series of holes connected by a solid line (Solid line indicates conducting path beneath) indicates conductive metal clip. Each metal clip is isolated from the other. Hence need to connect by external wired connections wherever necessary.

Number of holes arranged in a particular fashion: Bus strips and socket strips. You can observe bus strips on extreme right and extreme left side of the breadboard. Bus strips are usually used to provide power supply to the circuit. It consists of two columns, one for power voltage and other for ground.

Socket strip is used to hold most of the components in the circuit. IC should always fix in between two socket strips.

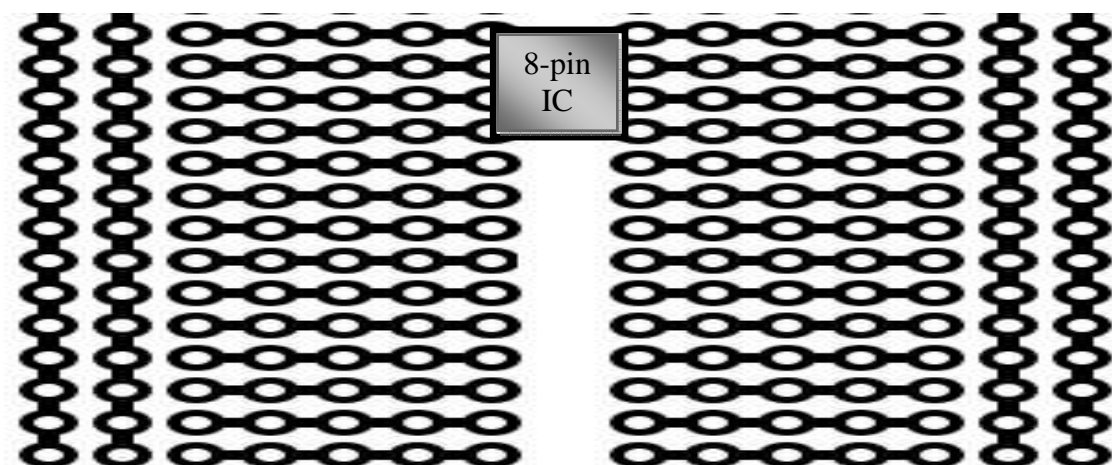


Fig:1.1: Layout of a general purpose Breadboard.

Q:1.7 Wire up the circuit to verify OR gate using given IC. Complete Table 1.2 with your observations.

<u>Input (Ax, Bx)</u>		<u>Output (C)</u>	<u>Observed Output</u>	<u>Logical Expression</u>
0	0	0		$A+B$
0	1	1		$A+B$
1	0	1		$A+B$
1	1	1		$A+B$

Table 1.2

Run # 06: Implementation of a simple digital circuit

Figure 1.2 shows implementation of three input logic gate using two input logic gate.

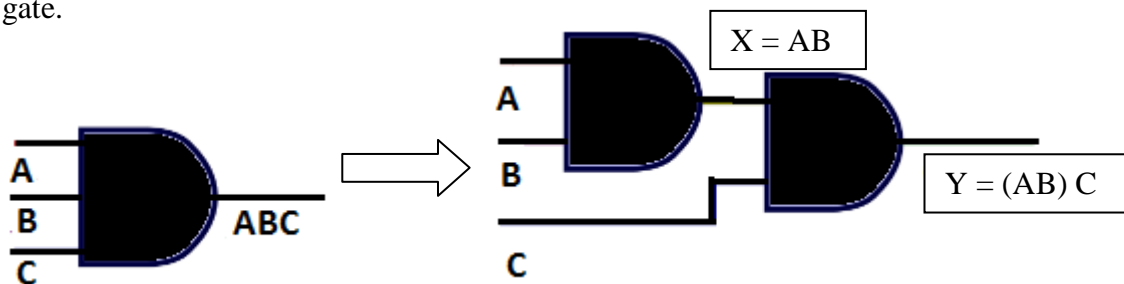


Figure: 1.2

Q:1.8 Wire up above circuit and observe outputs X and Y as shown in following TruthTable.(Table 1.3). Feed inputs either using toggle switches or from the power supply and observe the output on LEDs. Note down logical expression of the circuit.

A	B	X=AB	C	Y=ABC	Description/ Logic of circuit
0	0	0	0	0	
0	0	0	1	0	
0	1	0	0	0	
0	1	0	1	0	
1	0	0	0	0	
1	0	0	1	0	
1	1	1	0	0	
1	1	1	1	1	$A \cdot B \cdot C$

Table 1.3

Q:1.9 How many 7408 ICs are required to implement above circuit (Fig 1.2)?

Run # 07: Impementation of logical function in SOP form

Q:1.10 Write down boolean expressions for outputs at various stages of the circuit shown in figure 1.3.

- a = _____
- b = _____
- o = _____

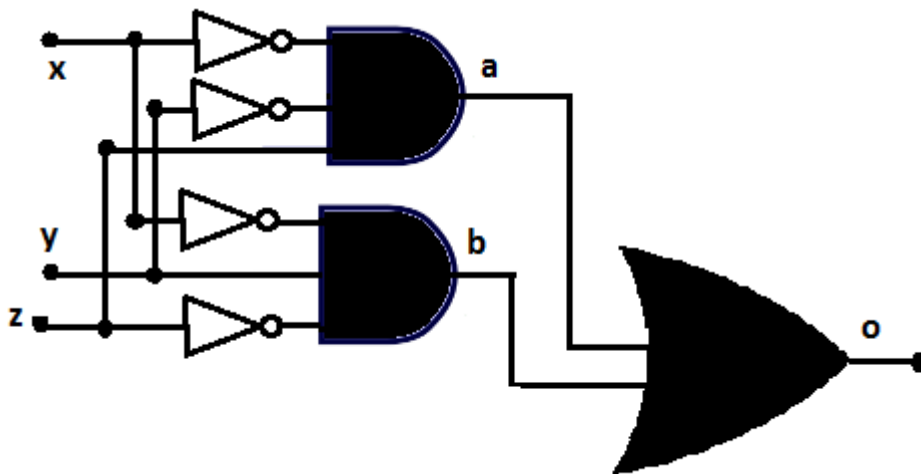


Fig 1.3

Q:1.11 Wire up above circuit (Figure 1.3). Feed inputs either using toggle switches or from the power supply and observe the output on LEDs. Note down your observations to complete the following truth table (Table 1.4).

x	y	z	a	b	o	Description/Logical expression (Only for o=1)	Terminal name at which Logic is observed (w.r.to circuit in Fig 1.3)
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

Table 1.4

Q:1.12 Logical Expression at output terminal 'o' = _____.
(This is simplified function for 'o' in Sum of Product form (SOP))

Q:1.13. Use negative logic to implement two functions F and F' of following fig 1.4. Inputs of both the circuits should be provided from same switches but output should be displayed with separate LEDs. Show that both of these circuits complements each other.

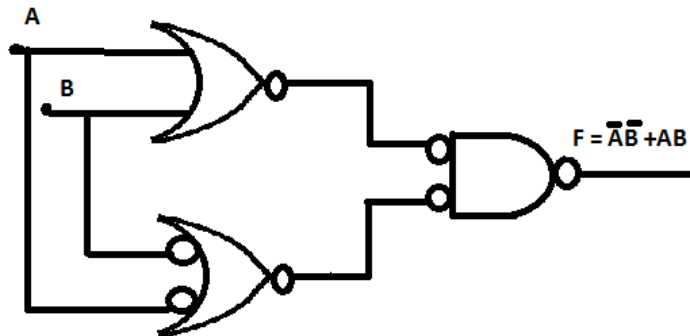
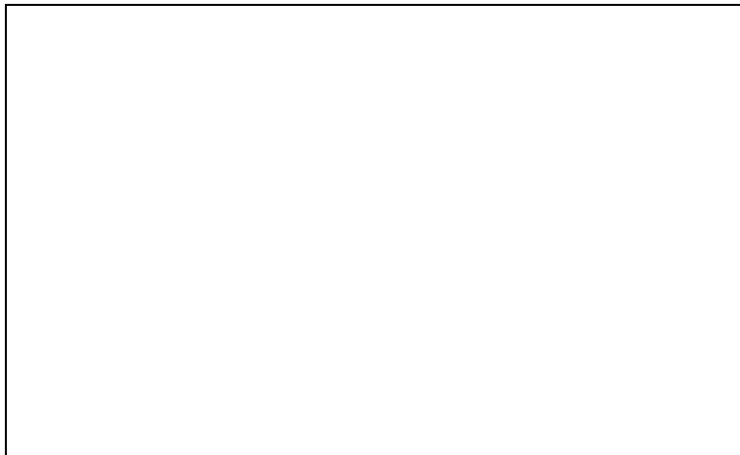


Fig 1.4

A	B	F
0	0	
0	1	
1	0	
1	1	

Table 1.5

- (a) Complete above Truth Table (Table 1.5) for the given circuit (Fig.1.4)
 (b) Draw circuit diagram and complete truth table for function F of Fig 1.4 using negative logic



A	B	F
0	0	
0	1	
1	0	
1	1	

- (c) Draw circuit diagram and complete truth table for function F' of Fig 1.4 using negative logic



A	B	F'
0	0	
0	1	
1	0	
1	1	

References:

- Datasheet of IC : 7432,7400,7408,7404