Digital Logic Design Lab

Department of Computer Science

IQRA NATIONAL UNIVERSITY, PESHAWAR

Contents

Course Learning Outcomes (CLOs)

Course Learning Outcomes (CLO):

Upon successful completion of the course, the students will be able to:

CLO1:

Understand fundamental concepts of digital logic design including basic and universal gates, number systems, binary coded systems, basic components of combinational and sequential circuits

CLO2:

Demonstrate the acquired knowledge to apply techniques related to the design and analysis of digital electronic circuits including Boolean algebra and multi-variable Karnaugh map methods

CLO3:

Analyze small-scale combinational and sequential digital circuits

CLO4:

Synthesize small-scale combinational and synchronous sequential digital circuit using Boolean algebra and K-maps

Lab 1: Verification of Gates

1.1 Aim

To study and verify the Truth Tables of AND, OR, NOT, NAND, NOR, XOR, XNOR logic gates for positive logic.

1.2 Objectives:

- To get familiar with the usage of the available lab equipment.
- To get familiar with Prototyping board (breadboard)
- To describe and verify the operation for the AND, OR, NOT, NAND, NOR, XOR, XNOR gates.
- To study the representation of these functions by truth tables, logic diagrams and Boolean algebra
- To Introduce a basic knowledge in integrated circuit devices operation
- To practice how to build a simple digital circuit using ICs and other digital components .
- Learn how to Wire a circuit

1.3 Apparatus/Equipment Required:

- Prototyping board (breadboard)
- DC Power Supply 5V
- Light Emitting Diode (LED)
- Digital ICs:
  - 7404 :Hex Inverter
  - 7408 :Quad 2 input AND

- 7432 :Quad 2 input OR
- 7400: Quad 2 input NAND
- 7402: Quad 2 input NOR
- 7486: Quad 2 input XOR
- 74266:Quad 2 input XNOR

• Connecting Wires

1.3.1 Pin Diagram

Figure1.1 shows the architecture of SAP-1, a bus-organized computer. All register outputs to the 8 bit W-bus are three states; this allows orderly transfer of data. All other register outputs are two state; these outputs continuously drive the boxes they are connected to. The layout of Fig.1.1 emphasizes the registers used in SAP- 1. For this reason, no attempt has been made to keep all control circuits in one block called the control unit, all input-output circuits in another block called the I/O unit, etc

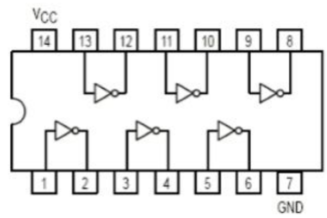
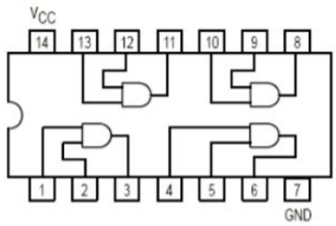
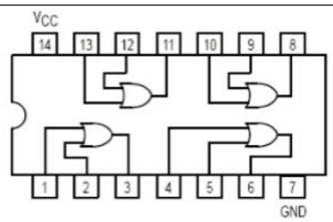
	**NOT Gate: IC 7404(HEX Inverter)** **14 Pin** **Supply voltage :5V**
	**AND Gate: IC 7408** **14 Pin** **Quad 2 input AND Gate** **Supply voltage :5V**
	**OR Gate: IC 7432** **14 Pin** **Quad 2 input OR Gate** **Supply voltage :5V**

Figure 1.1: Pin Specification of various Digital ICs.

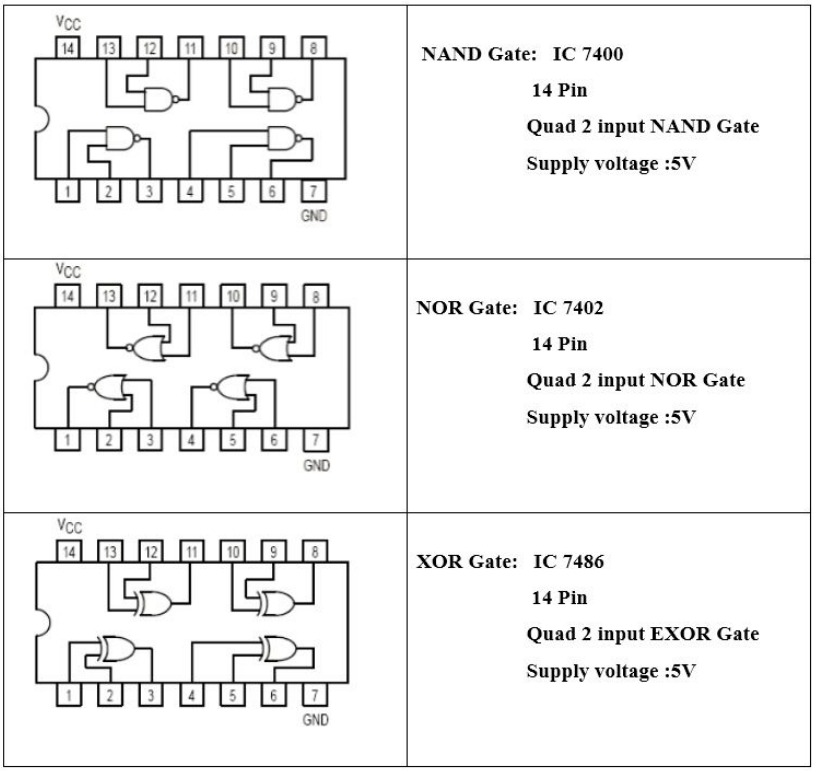


Figure 1.2: Pin Specification of various Digital ICs.

1.4 Theory

A Digital Logic Gate is an electronic device that makes logical decisions based on the different combinations of digital signals present on its inputs Logic gates are the building blocks of digital circuits. Combinations of logic gates form circuits designed with specific tasks in mind. They are fundamental to the design of computers. Digital logic using transistors is often referred as Transistor-Transistor Logic or TTL gates. These gates are the AND, OR, NOT, NAND, NOR, XOR and XNOR gates.

1.4.1 AND Gate

A multi-input circuit in which the output is 1 only if all inputs are 1.The symbolic representation of the AND gate is:

A dot (.) is used to show the AND operation i.e. A.B if A and B are the inputs to AND Gate.

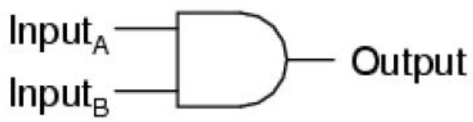


Figure 1.3: Logic Symbol of AND Gate

A	B	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

Figure 1.4: Truth Table for AND Gate

1.4.2 OR Gate

A multi-input circuit in which the output is 1 when any input is 1. The symbolic representation of the OR gate is shown:

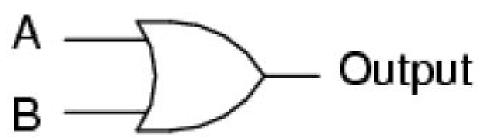


Figure 1.5: Logic Symbol of OR Gate

The OR gate is an electronic circuit that gives a high output (1) if one or more of its inputs are high. A plus (+) is used to show the OR operation.

A	B	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	1

Figure 1.6: Truth Table for OR Gate

1.4.3 NOT Gate

The output is 0 when the input is 1, and the output is 1 when the input is 0. The symbolic representation of an inverter is :

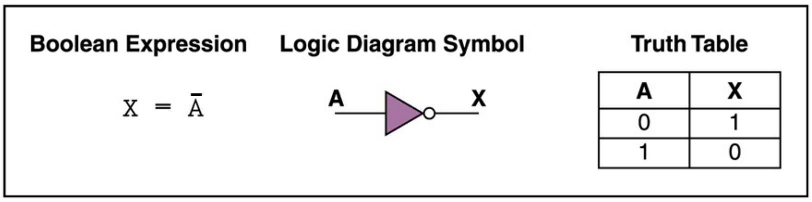


Figure 1.7: Logic Symbol and Truth Table for NOT gate

The NOT gate is an electronic circuit that produces an inverted version of the input at its output. It is also known as an inverter. If the input variable is A, the inverted output is known as NOT A. This is also shown as A′, or A with a bar over the top, as shown at the outputs.

1.4.4 NAND Gate

AND followed by INVERT. It is also known as universal gate. The symbolic representation of the NAND gate is:

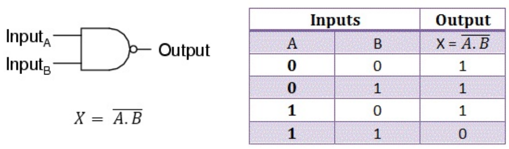


Figure 1.8: Logic Symbol and Truth Table for NAND gate

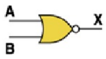
This is a NOT-AND gate which is equal to an AND gate followed by a NOT gate. The outputs of all NAND gates are high if any of the inputs are low. The symbol is an AND gate with a small circle on the output. The small circle represents inversion.

1.4.5 NOR Gate

OR followed by inverter. It is also known as universal gate. The symbolic representation is:

Boolean Expression **Logic Diagram Symbol** **Truth Table**

$X = \overline{(A + B)}$



A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

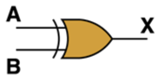
Figure 1.9: Logic Symbol and Truth Table for NOR gate

1.4.6 Exclusive-OR (XOR Gate)

The output of the Exclusive-OR (XOR) gate is 0 when its two inputs are the same and its output is 1 when its two inputs are different.

Boolean Expression **Logic Diagram Symbol** **Truth Table**

$X = A \oplus B$



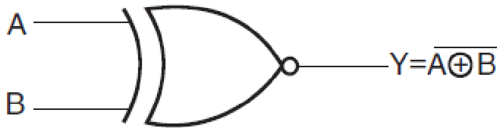
A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

Figure 1.10: Logic Symbol and Truth Table for XOR gate

The 'Exclusive-OR' gate is a circuit which will give a high output if either, but not both, of its two inputs are high. An encircled plus sign ( ) is used to show the XOR operation.

1.4.7 Exclusive-NOR (XNOR)

The XNOR gate is a digital logic gate whose function is the inverse of the operation exclusive OR (XOR) gate. The output of the Exclusive NOR gate, is 0 when its two inputs are the different and its output is 1 when its two inputs are same. An encircled plus sign and bar are used to show the XNOR operation.



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

$$Y = (\overline{A \oplus B}) = (A.B + \overline{A}.\overline{B})$$

Figure 1.11: Logic Symbol and Truth Table for XNOR gate

1.5 Procedure:

1. Collect the components necessary to accomplish this experiment.
2. Plug the IC chip into the breadboard.
3. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and $PIN14 = +5V$.
4. According to the pin diagram of each IC mentioned above, wire only one gate to verify its truth table.
5. Connect the inputs of the gate to the input switches of the LED.
6. Connect the output of the gate to the output LEDs.
7. Once all connections have been done, turn on the power switch of the breadboard
8. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.
9. Repeat the above steps 1 to 5 for all the ICs.

1.6 Observation Table:

Input variables: A and B
Output variable: Y
LED ON: Logic 1
LED OFF: Logic 0

1.7 Results and Analysis:

- NOT Gate: When logic 1 is applied to one of NOT gate of 7404 IC, then output becomes zero. When input LED is ON (RED), the output LED become OFF (Green) vice versa.

Table 1.1: Output Observation Table

S.No	Inputs		Outputs						
	A	B	NOT	AND	OR	NAND	NOR	XOR	XNOR
1									
2									
3									
4									

- OR Gate: The output of an OR gate is a 1 if one or the other or both of the inputs are 1, but a 0 if both inputs are 0. When One or the other or Both of the input LEDS are ON (RED Light), then output LED is ON(RED) otherwise Output LED is OFF(Green Light)
- AND Gate: The output of an AND gate is only 1 if both its inputs are 1. For all other possible inputs the output is 0.When both the LEDS are On, then output LED is ON (RED Light) otherwise Output LED is OFF.
- NOR Gate: The output of the NOR gate is a 1 if both inputs are 0 but a 0 if one or the other or both the inputs are 1. NAND Gate: The output of the NAND gate is a 0 if both inputs are 1 but a 1 if one or the other or both the inputs are 0.
- XOR gate: The output of the XOR gate is a 1 if either but not both inputs are 1 and a 0 if the inputs are both 0 or both 1.
- XNOR gate: The output of the ExclusiveâĂŞNOR gate, is 0 when its two inputs are the different and its output is 1 when its two inputs are same.

1.9 Conclusion:

Any Boolean expression can be realized using NOT, AND, OR, NAND, NOR, XOR, XNOR gates.

Lab 2:Half Adder

2.1 Aim

Design and verify the logic circuit of Half adder using logic gates.

2.2 Objectives

- To understand the principle of binary addition.
- To understand half adder concept.
- Use truth table and Boolean Algebra theorems in simplifying a circuit design.
- To implement half adder circuit using logic gates

2.3 Apparatus Required

- Prototyping board (breadboard)
- DC Power Supply +5V
- Light Emitting Diode (LED)
- Digital ICs:
  - 7408 :Quad 2 input AND
  - 7486: Quad 2 input XOR
  - 7432 :Quad 2 input OR

2.4 Pin Diagram:

2.5 Theory

Half Adder: A half adder is a logical circuit that performs an addition operation on two binary digits. The half adder produces a sum and a carry value which are both binary digits.

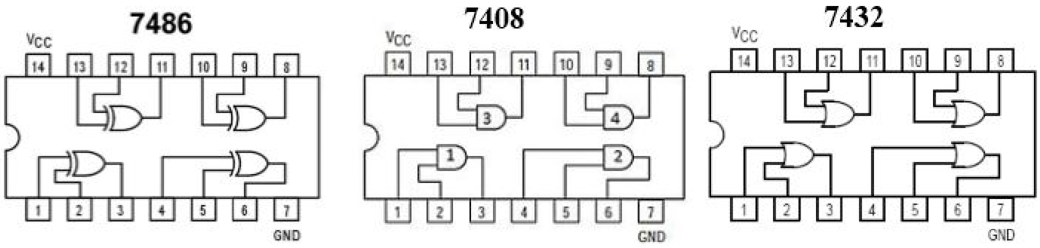
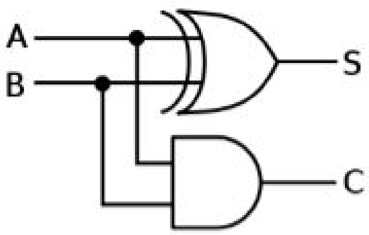


Figure 2.1: Pin Diagram for 7408, 7486 and 7432 ICs

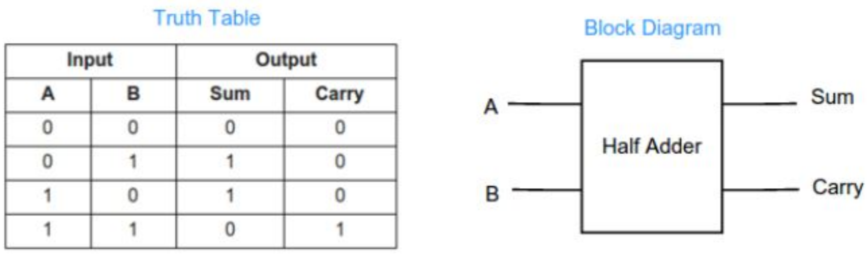


$$S = \overline{A} \cdot B + A \cdot \overline{B}$$
$$C = A \cdot B$$

Figure 2.2: Half Adder Logic circuit and Boolean expression for each outputs

2.6 Procedure:

1. Collect the components necessary to accomplish this experiment.
2. Plug the IC chip into the breadboard.
3. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.
4. According to the pin diagram of each IC mentioned above, make the connections according to circuit diagram.
5. Connect the inputs of the gate to the input switches of the LED.
6. Connect the output of the gate to the output LEDs.
7. Once all connections have been done, turn on the power switch of the breadboard
8. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.


Truth Table

Input		Output	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Figure 2.3: Half Adder Block diagram and Truth Table

2.7 Observation table

Half Adder Input Variable: A ,B
Output Variable: S, C
LED ON: RED Light: Logic 1
LED OFF: Green Light: Logic 0

Table 2.1: Output Observation Table

Inputs		**Outputs**	
A	B	Sum (S)	Carry C

2.8 Results and Analysis

Half Adder: Verified the truth table of Half Adder as S = 1 i.e. LED which is connected to S terminal glows when inputs are A ,B Verified the truth table of Half Adder as C = 1 i.e LED which is connected to C terminal glows when inputs are A, B.

2.9 Conclusion:

- To add two bits we require one XOR gate(IC 7486) to generate Sum and one AND (IC 7408) to generate carry.
- To add three bits we require two half adders.

Lab 3: Full Adder

3.1 Aim

Design and verify the logic circuit Full adder using Half adder.

3.2 Objective:

- To understand the principle of binary addition.
- To understand full adder concept.
- Use truth table and Boolean Algebra theorems in simplifying a circuit design.
- To implement full adder circuit using logic gates.

3.3 Apparatus Required

- Prototyping board (breadboard)
- DC Power Supply 5V Battery
- Light Emitting Diode (LED)
- Digital ICs:
  - 7408 :Quad 2 input AND
  - 7486: Quad 2 input XOR
  - 7432 :Quad 2 input OR
- Connecting Wires

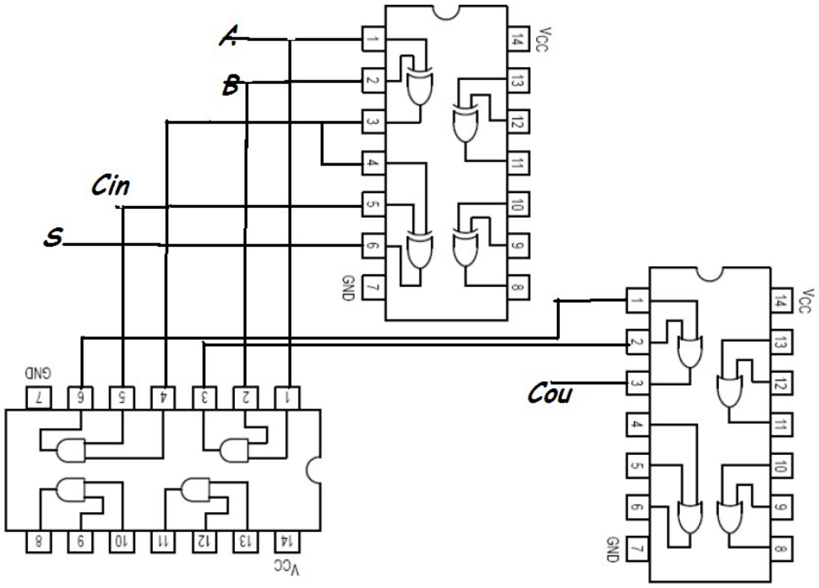


Figure 3.1: Pin diagram of Full adder

3.4 Pin Diagram

3.5 Theory

Full Adder: Full adder is a logical circuit that performs an addition operation on three binary digits. The full adder produces a sum and carry value, which are both binary digits. It can be combined with other full adders or work on its own.

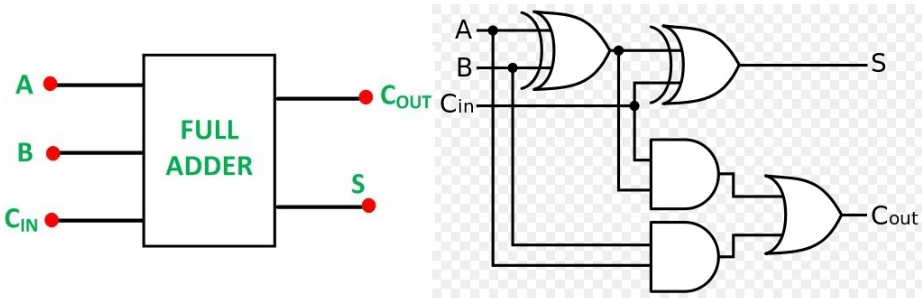


Figure 3.2: Logic circuit and block diagram of Full Adder

3.6 Procedure:

1. Collect the components necessary to accomplish this experiment.
2. Plug the IC chip into the breadboard.

Full adder truth table

S= A ⊕ B ⊕ Cin
C=AB + Cin (A ⊕ B)

A	B	Carry-In	Sum	Carry-Out
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Figure 3.3: Boolean Expression and Truth Table for Full Adder

3. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.

4. According to the pin diagram of each IC mentioned above, make the connections according to circuit diagram.

5. Connect the inputs of the gate to the input switches of the LED.

6. Connect the output of the gate to the output LEDs.

7. Once all connections have been done, turn on the power switch of the breadboard

8. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.

3.7 Observation Table

Full adder: Input Variable: A ,B,Ci Output Variable: SUM(S), Carry(C_0) LED ON: RED Light: Logic 1 LED OFF: Green Light: Logic 0

Table 3.1: Add caption

Inputs			Outputs	
A	B	Ci	Sum (S)	Carry Âľ

3.8 Results And Analysis

Verified the truth table as follows.

Full Adder: Verified the truth table of Full Adder as S = 1 i.e LED which is connected to S terminal glows when inputs are A ,B ,Ci Verified the truth table of Full Adder as Co = 1 i.e LED which is connected to Co terminal glows when inputs are A ,B, Co

3.9 Conclusion:

1. To add two bits we require one XOR gate(IC 7486) to generate Sum and one AND (IC 7408) to generate carry. 2. To add three bits we require two half adders.

Lab 4: Half Subtractor

4.1 Aim

Design and verify the logic circuit of Half-subtractor using logic gate.

4.2 Objective:

- To understand the principle of binary subtraction.
- To understand half-subtractor concept.
- Use truth table and Boolean Algebra theorems in simplifying a circuit design.
- To implement half-subtractor circuit using logic gates

4.3 Apparatus Requirement:

- Prototyping board (breadboard)
- DC Power Supply 5V Battery
- Light Emitting Diode (LED)
- Digital ICs:
  - 7408 :Quad 2 input AND
  - 7486: Quad 2 input XOR
  - 7432 :Quad 2 input OR
  - 7404: Hex inverter (NOT Gate)
- Connecting Wires

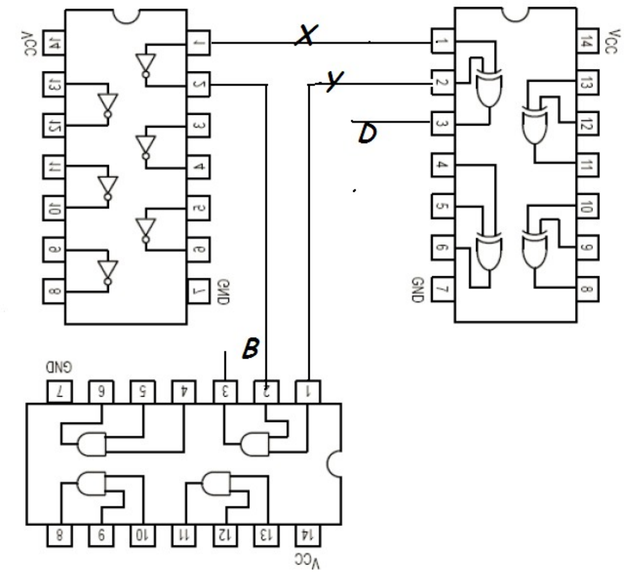


Figure 4.1: Pin Diagram of Half-Subtractor

4.4 Pin Diagram:

4.5 Theory:

Half Subtractor: The half-subtractor is a combinational circuit which is used to perform subtraction of two bits. It has two inputs, X (minuend) and Y (subtrahend) and two outputs D (difference) and B (borrow).

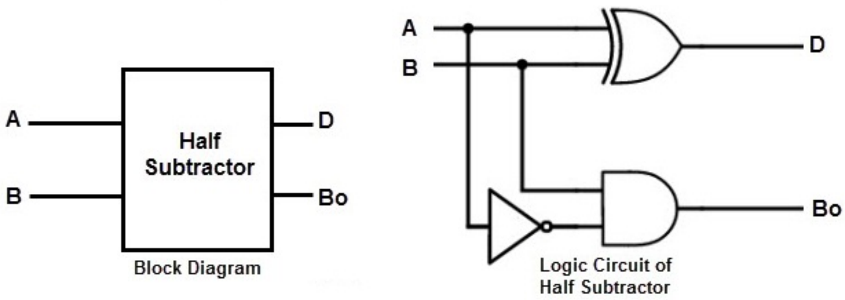


Figure 4.2: Logic Circuit and Block diagram of half-subtractor

4.6 Procedure:

- Collect the components necessary to accomplish this experiment.
- Plug the IC chip into the breadboard.

A	B	D	B_0
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Truth Table

$D = A + B$

$B = A\bar{B}$

Boolean Expression

Figure 4.3: Truth Table and Boolean expression of half-subtractor

- Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.
- According to the pin diagram of each IC mentioned above, make the connections according to circuit diagram.
- Connect the inputs of the gate to the input switches of the LED.
- Connect the output of the gate to the output LEDs.
- Once all connections have been done, turn on the power switch of the breadboard
- Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.

4.7 Observation Table:

Full Subtractor: Input Variable: A,B,BIN, D,BOUT Output Variable: D,B LED ON: RED Light: Logic 1 LED OFF: Green Light: Logic 0

Table 4.1: Output Observation Table

Inputs		**Outputs**	
A	B	D	B_0

4.8 Results and Analysis:

Verified the truth table as follows. Full Subractor: Verified the truth table of Full Subtractor as D = 1 i.e LED which is connected to D terminal glows when inputs are X, Y ,BIN Verified the truth table of Full Subtractor as BOUT = 1 i.e LED which is connected to BOUT terminal glows when inputs are X ,Y, BIN

4.9 conclusion:

- To add two bits we require one XOR gate(IC 7486) to generate Difference and one AND (IC 7408) and NOT Gate(IC 7432) to generate Borrow.
- To add three bits we require two half subtractor.

Lab 5: Full Subtractor

5.1 Aim

Design and verify the logic circuit of Full subtractor using of Half subtractor.

5.2 Objective:

- To understand the principle of binary subtraction.
- To understand full subtractor concept.
- Use truth table and Boolean Algebra theorems in simplifying a circuit design.
- To implement full subtractor circuit of Half subtractor

5.3 Apparatus Requirement:

- Prototyping board (breadboard)
- DC Power Supply 5V
- Light Emitting Diode (LED)
- Digital ICs:
  - 7408 :Quad 2 input AND
  - 7486: Quad 2 input XOR
  - 7432 :Quad 2 input OR
  - 7404: Hex inverter (NOT Gate)
- Connecting Wires

5.4 Pin Diagram:

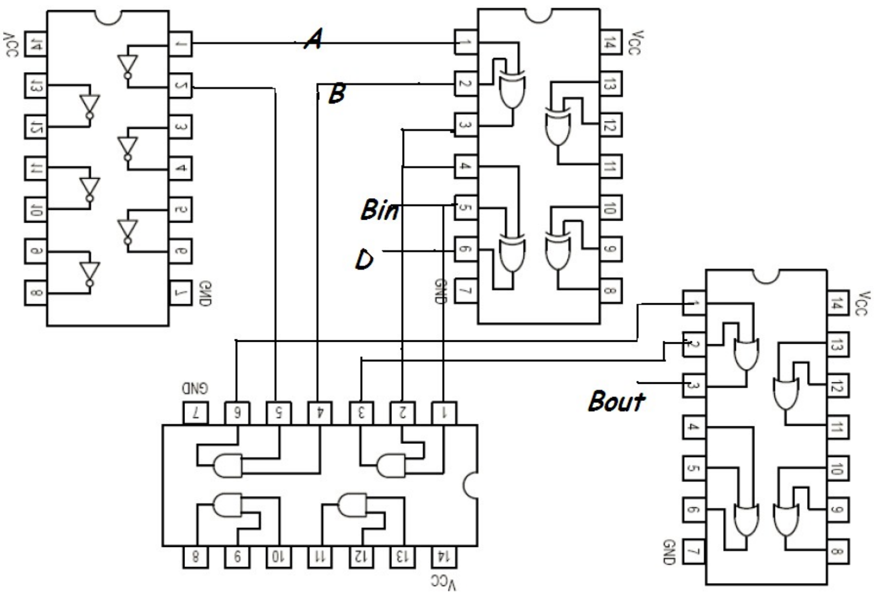


Figure 5.1: Pin Diagram of Full Subtractor

5.5 Theory:

Full subtractor: A full Subtractor is combinational circuit that performs a subtraction between three bits, taking into account that a âĂŸ1âĂŹ may have been borrowed by a lower significant stage. The 3 inputs denote minuend, subtrahend and previous borrow, respectively. The 2 outputs are difference(D) and borrow(B).

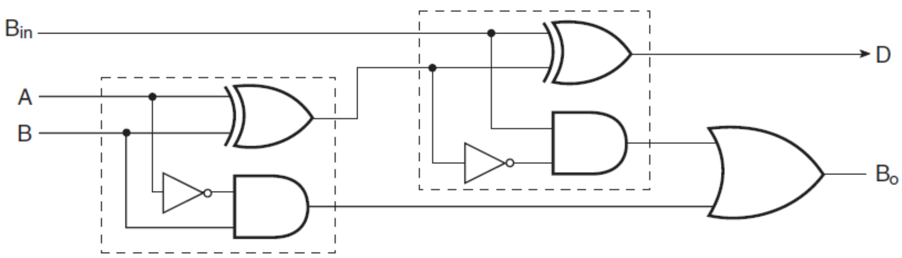


Figure 5.2: Logic Circuit of half subtractor

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

Figure 5.3: Truth Table of Full subtractor

5.6 Procedure:

1. Collect the components necessary to accomplish this experiment.
2. Plug the IC chip into the breadboard.
3. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.
4. According to the pin diagram of each IC mentioned above, make the connections according to circuit diagram.
5. Connect the inputs of the gate to the input switches of the LED.
6. Connect the output of the gate to the output LEDs.
7. Once all connections have been done, turn on the power switch of the breadboard
8. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.

5.7 Observation Table:

Input Variable: x ,y Output Variable: D,B LED ON: RED Light: Logic 1 LED OFF: Green Light: Logic 0

Table 5.1: Add caption

Inputs			Outputs	
A	B	B_in	D	B_out

5.8 Results and Analysis:

Verified the truth table as follows. Full Subtractor: Verified the truth table of Full Subtractor as D = 1 i.e LED which is connected to D terminal glows when inputs are X, Y ,BIN Verified the truth table of Full Subtractor as BOUT = 1 i.e LED which is connected to BOUT terminal glows when inputs are X ,Y, BIN

5.9 conclusion:

- To add two bits we require one XOR gate(IC 7486) to generate Difference and one AND (IC 7408) and NOT Gate(IC 7432) to generate Borrow.
- To add three bits we require two half subtractor.

Lab 6: Multiplexer

6.1 Aim

To the Truth Table of 4:1 Multiplexer using IC 74153.

6.2 Objective:

- To get familiar with the concept of multiplexing
- To get familiar with MSI (medium scale integration) technology.

6.3 Apparatus Required:

- Prototyping board (breadboard)
- DC Power Supply 5V
- Light Emitting Diode (LED)
- Digital ICs:74153:Dual 4:1 MUX
- Connecting Wires

6.4 Apparatus Requirement:

- Prototyping board (breadboard)
- DC Power Supply 5V
- Light Emitting Diode (LED)
- Digital ICs:
  - 7408 :Quad 2 input AND

- 7486: Quad 2 input XOR
- 7432 :Quad 2 input OR
- 7404: Hex inverter (NOT Gate)

- Connecting Wires

6.5 Pin Diagram:

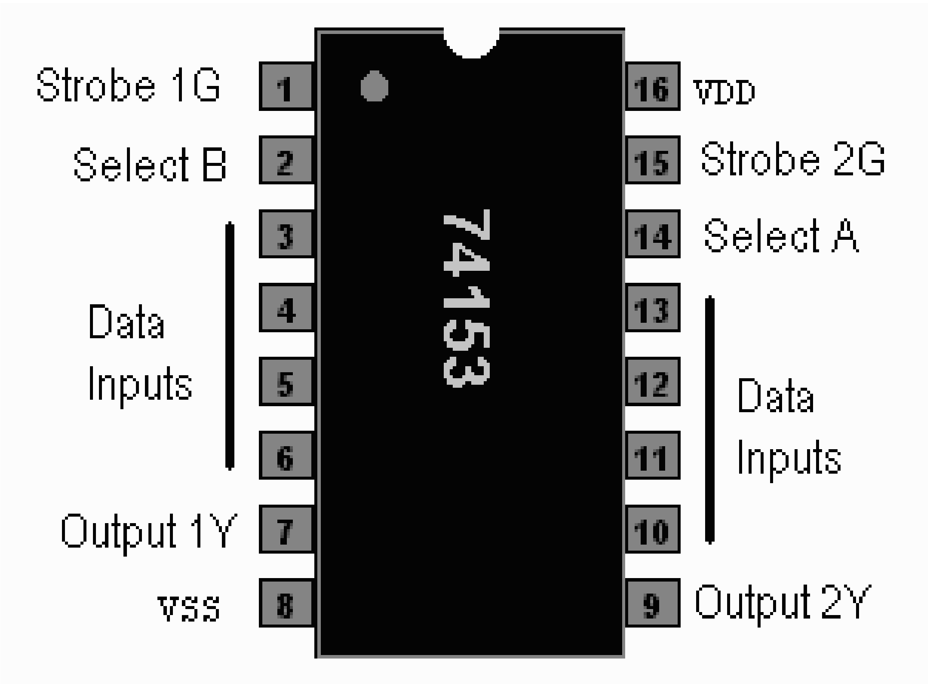


Figure 6.1: Pin Diagram of 4 x 1 Multiplexer

6.6 Theory:

Multiplexer: A data selector, more commonly called a Multiplexer, shortened to "MUX" or "MPX", is combinational logic switching devices that operate like a very fast acting multiple position rotary switches. They connect or control, multiple input lines called "channels" consisting of either 2, 4, 8 or 16 individual inputs, one at a time to an output. Then the job of a multiplexer is to allow multiple signals to share a single common output. For example, a single 8-channel multiplexer would connect one of its eight inputs to the single data output.

The Boolean expression for this 4-to-1 Multiplexer above with inputs I0 to I3 and data select lines S0 ,S1 is given as: $Y = S0S1I0 + S0S1I1 + S0S1I2 + S0S1I3$

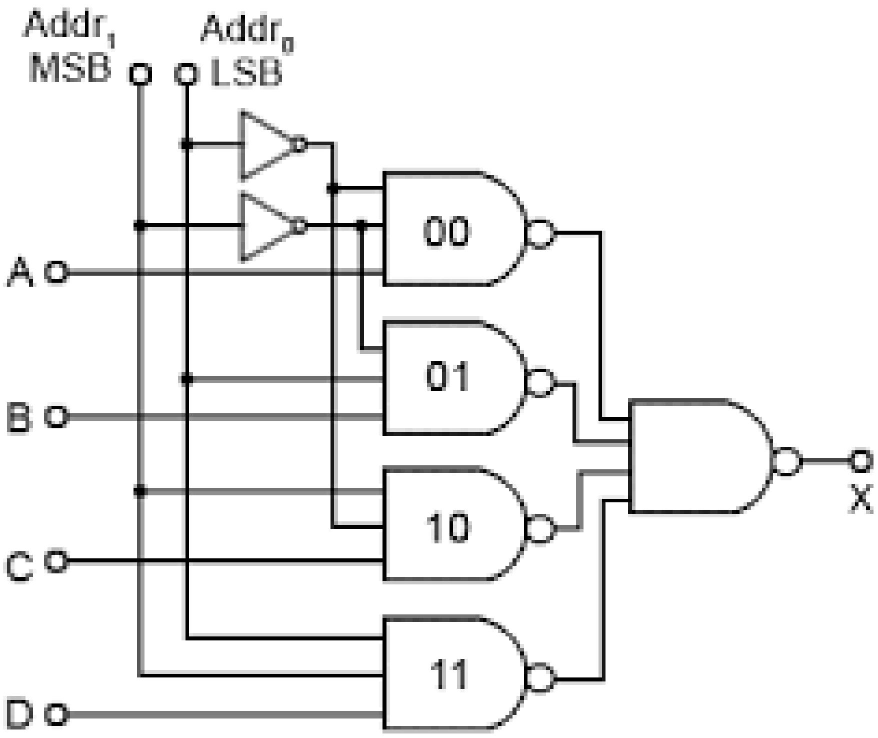
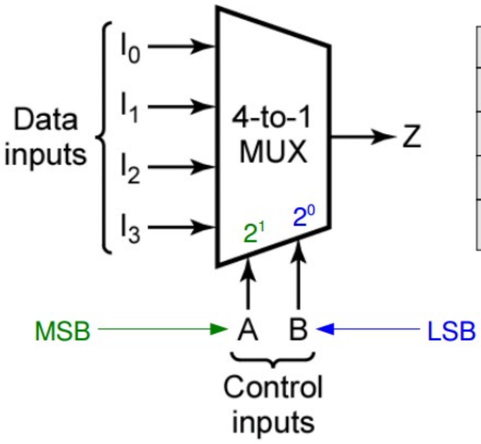


Figure 6.2: Logic Circuit of 4X1 MUX

6.7 Procedure:

1. Collect the components necessary to accomplish this experiment.
2. Plug the IC chip into the breadboard.
3. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.
4. Make connections as shown in the respective circuit diagram.
5. Connect the inputs of the gate to the input switches of the LED.
6. Connect the output of the gate to the output LEDs.
7. Once all connections have been done, turn on the power switch of the breadboard
8. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if L1 is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.



A	B	Z
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

$m_0 = A'.B'$
$m_1 = A'.B$
$m_2 = A.B'$
$m_3 = A.B$

Figure 6.3: Truth Table and Block diagram of 4x1 MUX

6.8 Observation Table:

Input Lines: I3,I2, I1 ,I0 Select Lines: S1, S0 Output Variable: Z LED ON: RED Light: Logic 1 LED OFF: Green Light: Logic 0

Table 6.1: Add caption

Select Lines		**Output**
S1	**S0**	**Z**

6.9 Results and Analysis:

Verified the truth table as follows. The input data was routed to output by varying the addresses on select lines

6.10 Conclusion:

The truth table of 4:1 MUX using IC 74153 has been

verified.

Lab 7: De-Multiplexer

7.1 Aim

To the Truth Table of 1:4 De-multiplexer using IC 74139

7.2 Objective:

- To get familiar with the concept of de-multiplexing

7.3 Apparatus Required:

- Prototyping board (breadboard)
- DC Power Supply 5V
- Light Emitting Diode (LED)
- Digital IC:74139:Dual 1:4 DEMUX
- Connecting Wires

7.4 Pin Diagram:

7.5 Theory:

De-multiplexer: The data distributor, known more commonly as a Demultiplexer or "Demux", is the exact opposite of the Multiplexer. The demultiplexer takes one single input data line and then switches it to any one of a number of individual output lines one at a time. The demultiplexer converts a serial data signal at the input to a parallel data at its output lines.

The Boolean expression for this 1-to-4 DeMultiplexer above with inputs I0 to I3 and data select lines S0 ,S1 is given as: $Y = S0S1D0 + S0S1D1 + S0S1D2 + S0S1D3$

The function of the Demultiplexer is to switch one common data input line to any one of the 4 output data lines. Some standard demultiplexer ICÂť's also have an

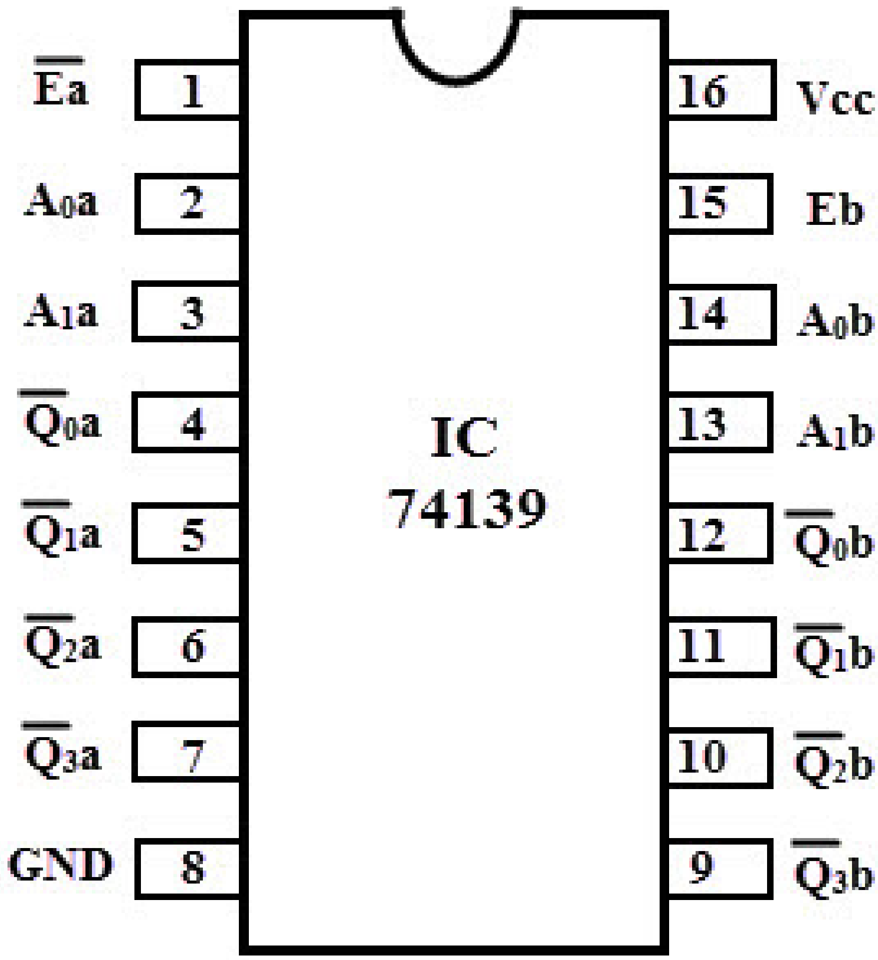
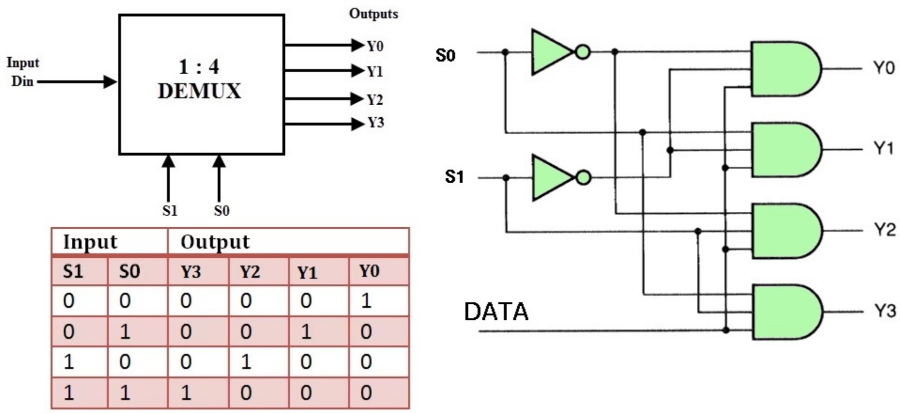


Figure 7.1: Pin Diagram of of dual 1 X 4 Demultiplexer

"enable output" input pin which disables or prevents the input from being passed to the selected output. Also some have latches built into their outputs to maintain the output logic level after the address inputs have been changed. However, in standard decoder type circuits the address input will determine which single data output will have the same value as the data input with all other data outputs having the value of logic "0".

7.6 Procedure:

1. Collect the components necessary to accomplish this experiment.
2. Plug the IC chip into the breadboard.
3. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.



Input		Output			
S1	S0	Y3	Y2	Y1	Y0
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

Figure 7.2: Block diagram, logic circuit and truth table for 1:4 Demultiplxer

4. Make connections as shown in the respective circuit diagram.
5. Connect the inputs of the gate to the input switches of the LED.
6. Connect the output of the gate to the output LEDs.
7. Once all connections have been done, turn on the power switch of the breadboard.
8. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if L1 is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.

7.7 Observation Table:

Input Variable: D, S0, S1 Output Variable: Y0, Y1, Y2, Y3 LED ON: RED Light: Logic 1 LED OFF: Green Light: Logic 0

Table 7.1: Add caption

Select Lines		Data Input	Output			
S1	**S0**	**Data**	**Y**	**Y2**	**Y1**	**Y0**

7.8 Results and Discussion:

Multiplexer and demultiplexer help in reducing the cost of transmission of digital signals. Logic design is simple and boolean expression need not be simplified. Mux and Demux acts as rotary switches. Multiplexers are used as one method of reducing the number of logic gates required in a circuit or when a single data line is required to carry two or more different digital signals i.e it converts parallel data into serial data and also used for data selection. The demultiplexer converts a serial data signal at the input to a parallel data at its output lines and used for data distribution. Both are available as ICs.

7.9 Conclusion:

1:4 DEMUX using IC74139 has been verified.