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# Objectives

**The main objectives of the lab are:**

- To get familiar with multiplexer and demultiplexer
- Design and construct Multiplexer and Demultiplexer
- Verify their Truth Table using basic logic Gates

# Components

- Two 7411, 3 I/P AND gates
- 7432, 2 I/P OR gate
- 7404, hex inverter
- Breadboard
- Jumper Wires
- Power Supply
- LEDs

# Theory Overview

## Multiplexer

Multiplexer is a data selector which takes several inputs and gives a single output. In multiplexer we have 2n input lines and 1 output lines where n is the number of selection lines. Multiplexer means many into one. A multiplexer is a circuit used to select and route any one of the several input signals to a single output. The multiplexer used for digital applications, also called digital multiplexer, is a circuit with many inputs but only one output. By applying control signals (also known as Select Signals), we can steer any input to the output. Some of the common types of multiplexers are 2-to-1, 4-to-1, 8-to-1, 16-to-1 multiplexer.

It is known as Data Selector. It follows combinational logic type. It works on many to one operational principle.

## Block Diagram

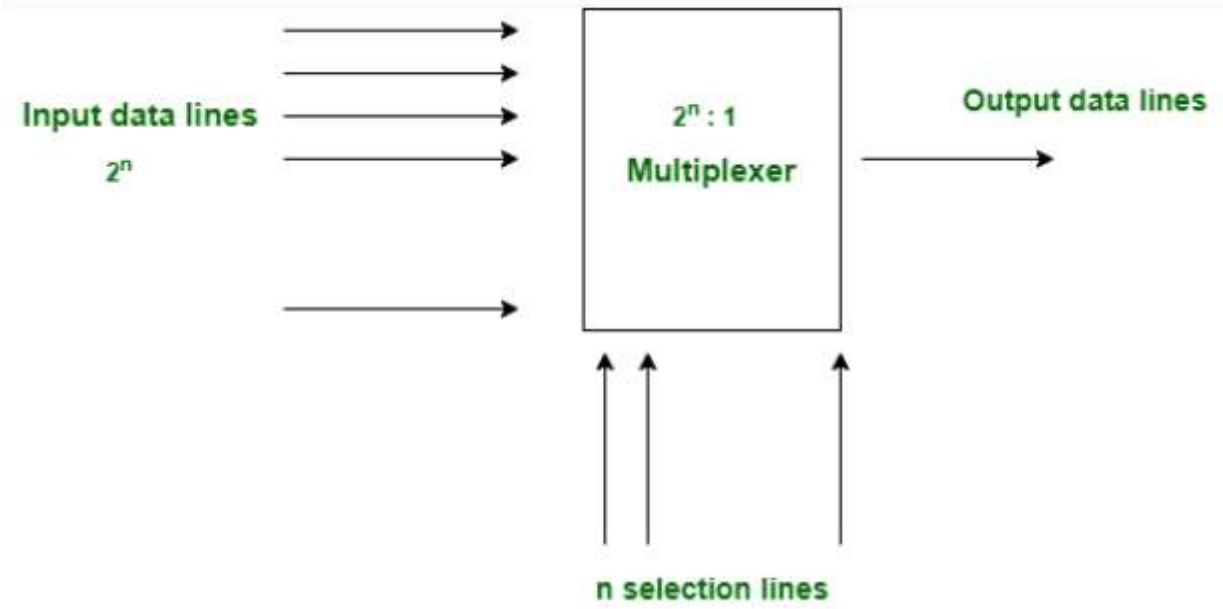



*Figure 1: Multiplexer Diagram*

# Circuit Diagram

The circuit diagram of 4x1 multiplexer is shown in the following figure.

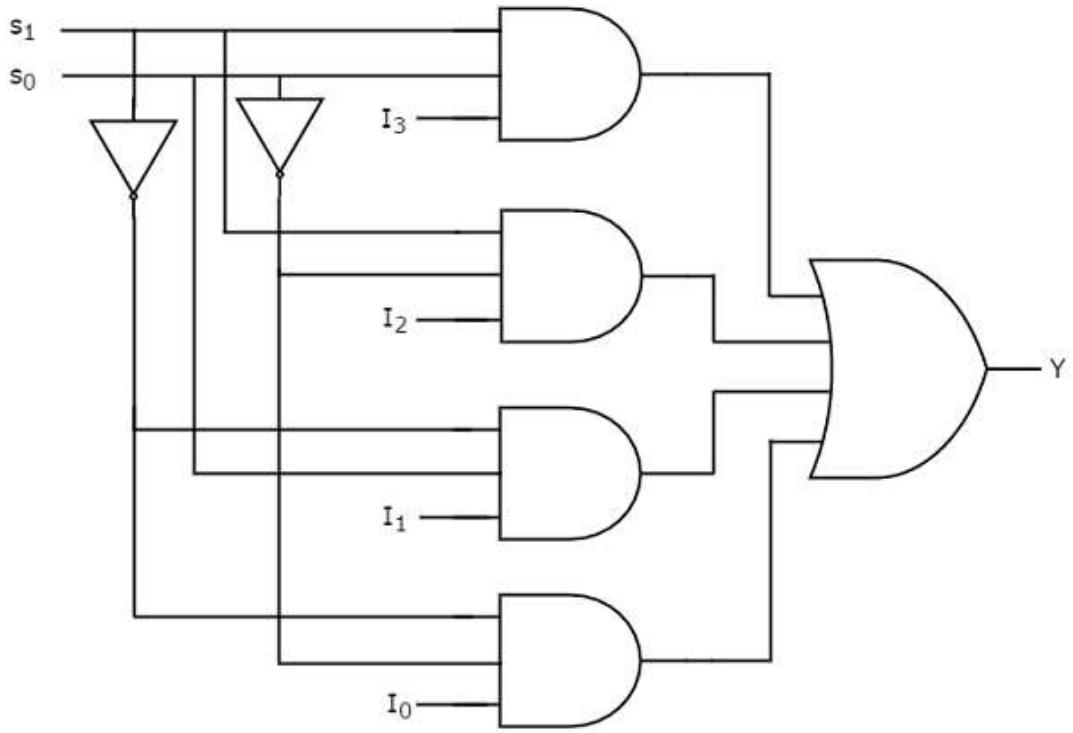



*Figure 2: Multiplexer Circuit Diagram*

## Truth Table

| S0 | S1 | Y= OUTPUT |
|---|---|---|
| 0 | 0 | D0 |
| 0 | 1 | D1 |
| 1 | 0 | D2 |
| 1 | 1 | D3 |

## Output Function

The output function from the table is :

$$Y = D0\ S1'\ S0' + D1\ S1'\ S0 + D2\ S1\ S0' + D3\ S1\ S0$$

## Demultiplexer

Demultiplexer is a data distributor which takes a single input and gives several outputs. In demultiplexer we have 1 input and 2n output lines where n is the selection line. By applying control signal, we can steer any input to the output. Few types of demultiplexer are 1-to 2, 1-to-4, 1-to-8 and 1-to 16 demultiplexer.

It is known as Data Distributor. It also follows combinational logic type. It works on one to many operational principle.

## Block Diagram

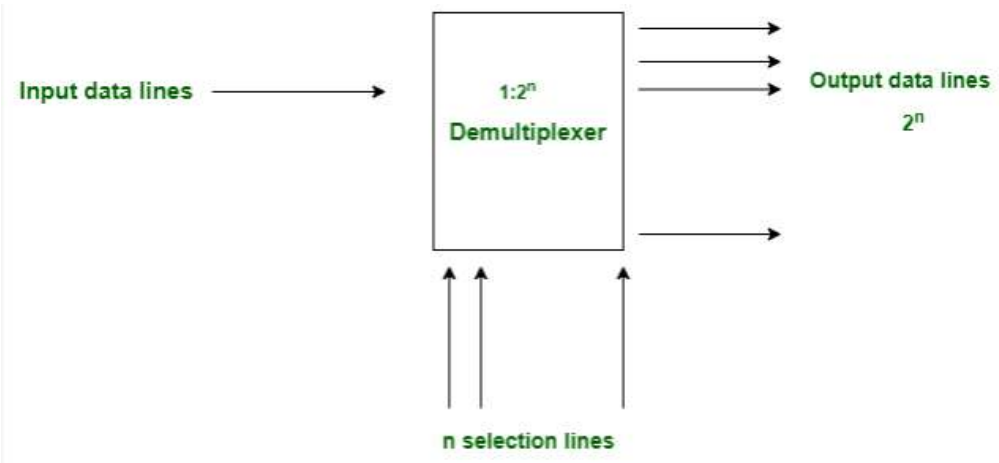



*Figure 3: De-MUX Block Diagram*

# Circuit Diagram

The circuit diagram of 1x4 De-Multiplexer is shown in the following figure.

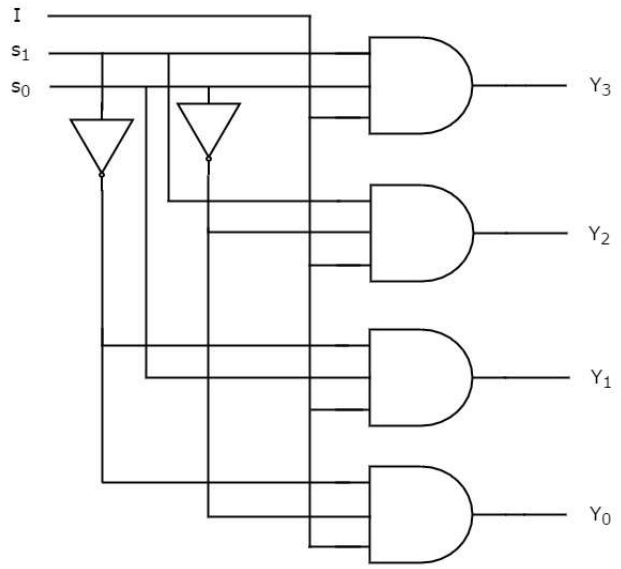



*Figure 4: De-MUX Circuit Diagram*

# Truth Table

| INPUT | | | OUTPUT | | | |
|---|---|---|---|---|---|---|
| S1 | S2 | I/P | D0 | D1 | D2 | D3 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 |

# Output Function

The output function from the above table is :

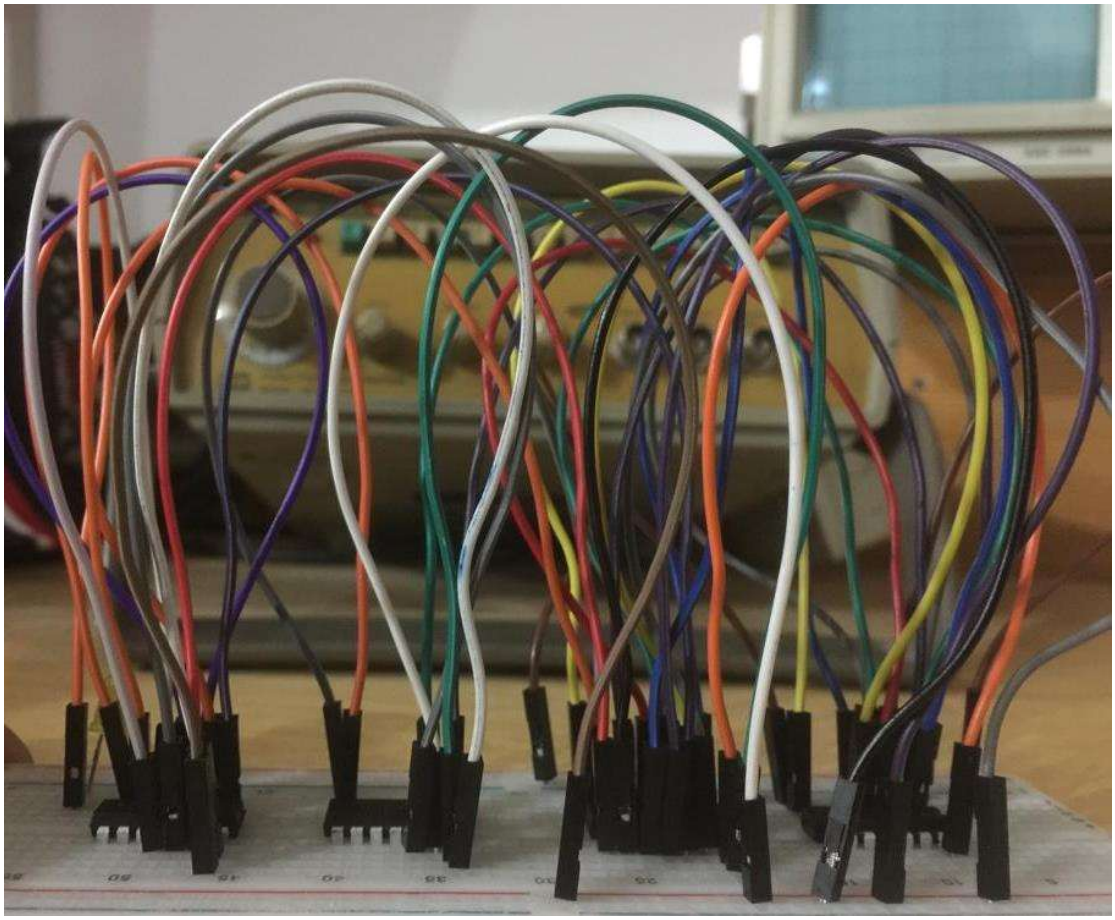
**Y = X S1’ S0’ + X S1’ S0 + X S1 S0’ + X S1 S0**

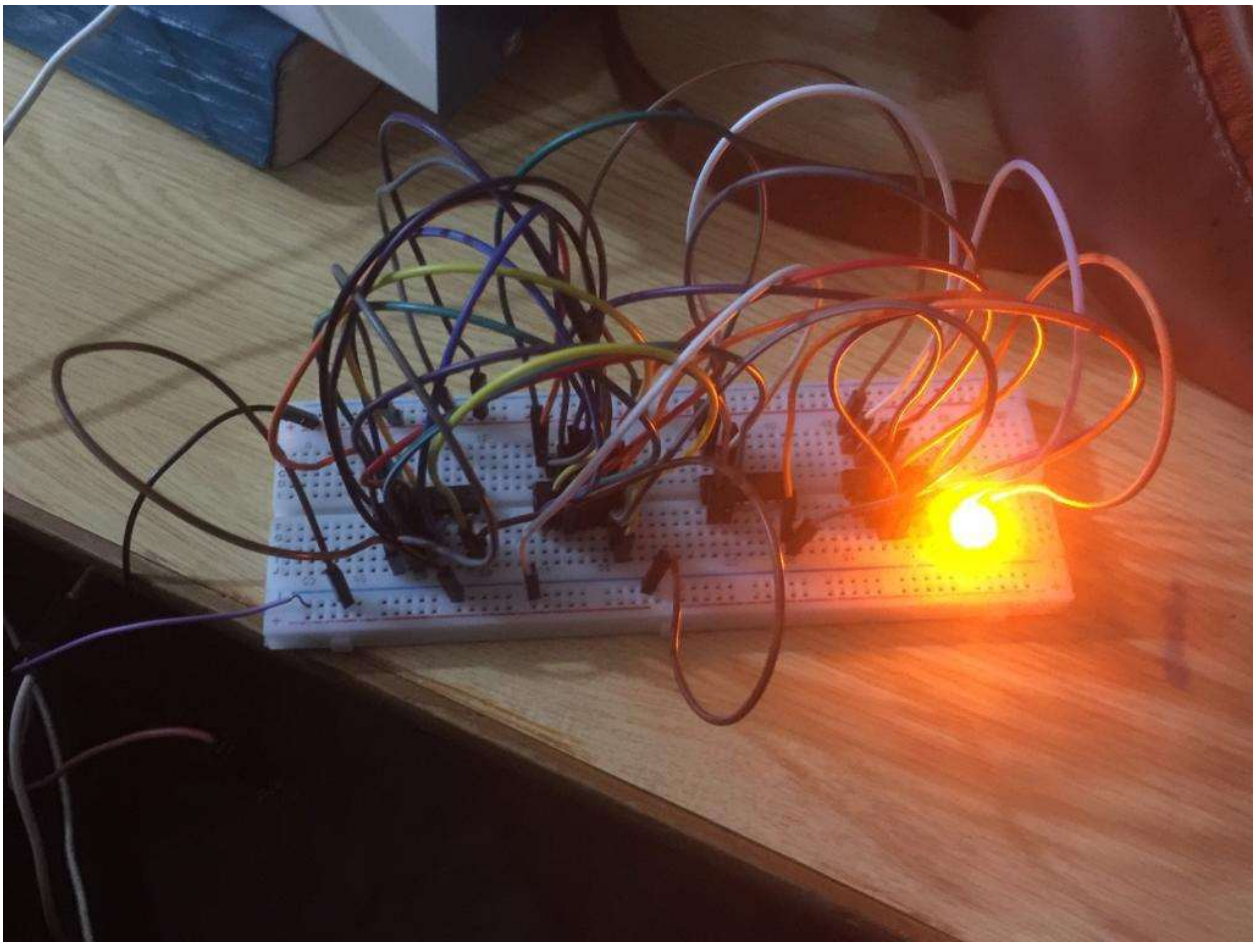
# Procedure

1. Connections are given as per circuit diagram.
2. Logical inputs are given as per circuit diagram.
3. Observe the output and verify the truth table.

# Implementing MUX and De-MUX:

## Implementing 4x1 MUX in LAB





# Implementing 1x4 De-MUX in Logisim

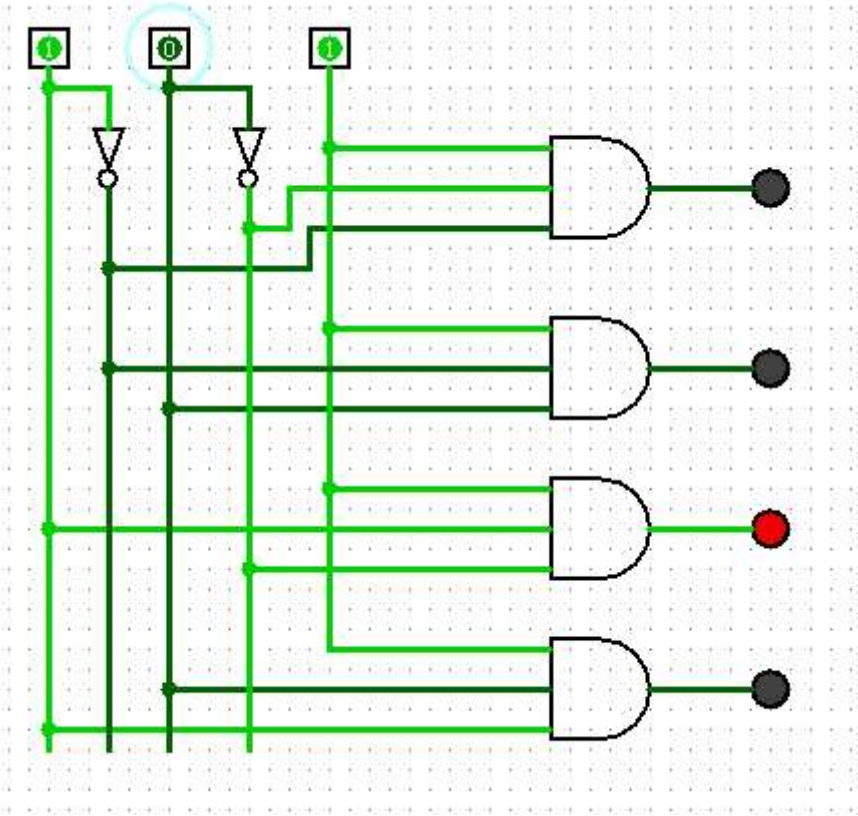


*Figure 5: 1x$ Demultiplexer*

# Review Questions

1. **What is the difference between Multiplexer and De-Multiplexer?**

| MUX | De-MUX |
|---|---|
| ▪ A multiplexer is a combinational circuit that provides single output but accepts multiple data inputs. | ▪ A demultiplexer is a combinational circuit that takes single input but that input can be directed through multiple outputs. |
| ▪ It has multiple data inputs | ▪ it has a single input |
| ▪ It has a single output | ▪ It has multiple output |
| ▪ It is N to 1 device and thus behaves as data selector. | ▪ It is 1 to N device and thus behaves as data distributor. |
| ▪ It can performs parallel to serial conversion | ▪ It can perform serial to parallel conversion. |
| ▪ The different types of multiplexers are 8-1 MUX, 16-1 MUX, and 32-1 MUX. | ▪ The different types of demultiplexers are 1-8 Demux, 1-16 Demux, 1-32 Demux. |

## 2. Design a 8x1 MUX using two 4x1 MUXes (74153) and a 2x1 MUX (74157)

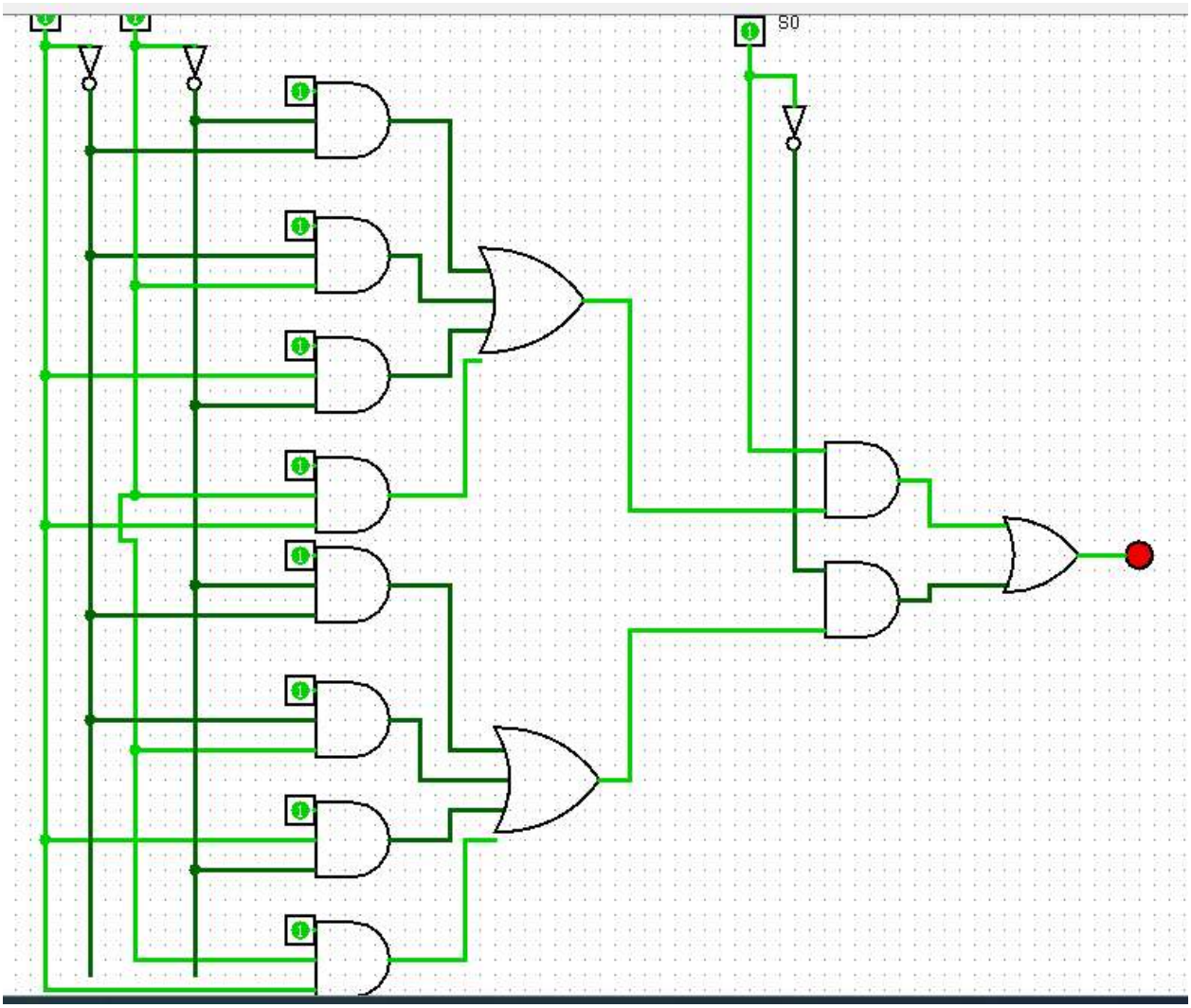



*Figure 6: 8x1 MUX*