# Lab Report 3

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## Experiment 3 (Part A) - Multiplexer [MUX] using Basic Logic Gates

### Objective:

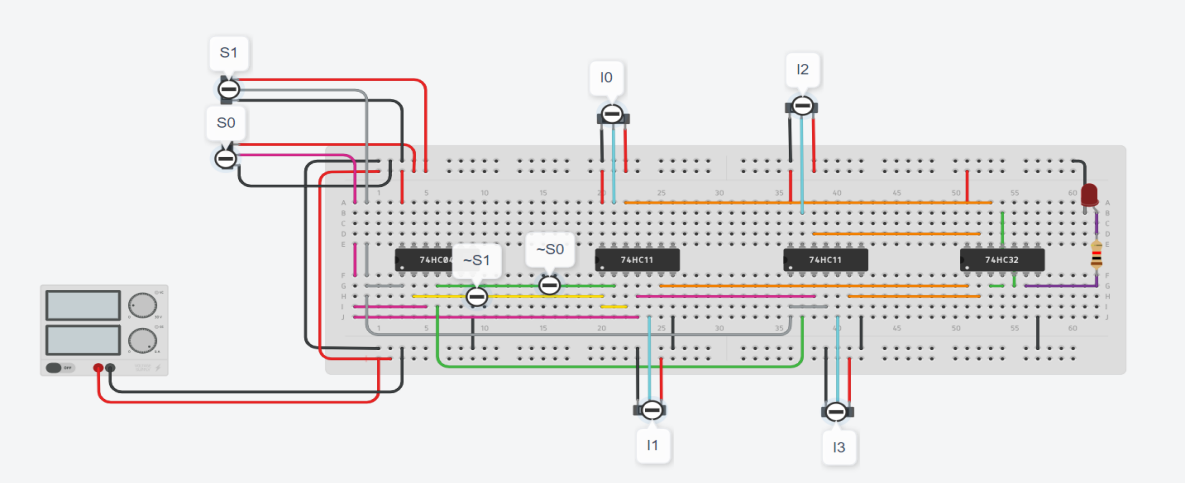
To design and make a Multiplexer(4:1) using logic gates.

### Electronic Components Required:

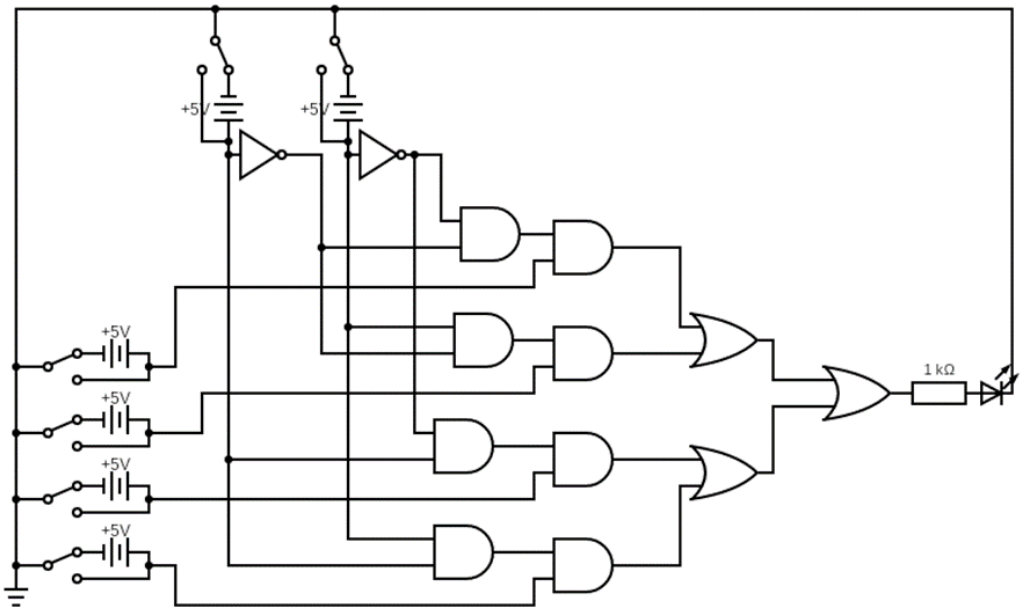
1. Digital Test Kit
2. 74HC04 IC NOT Gate
3. 74HC11 IC Triple Input AND Gate
4. 74HC32 IC OR Gate
5. Voltage Supply
6. Normal Wires

### Reference Circuit:

1. Tinkercad Screenshot



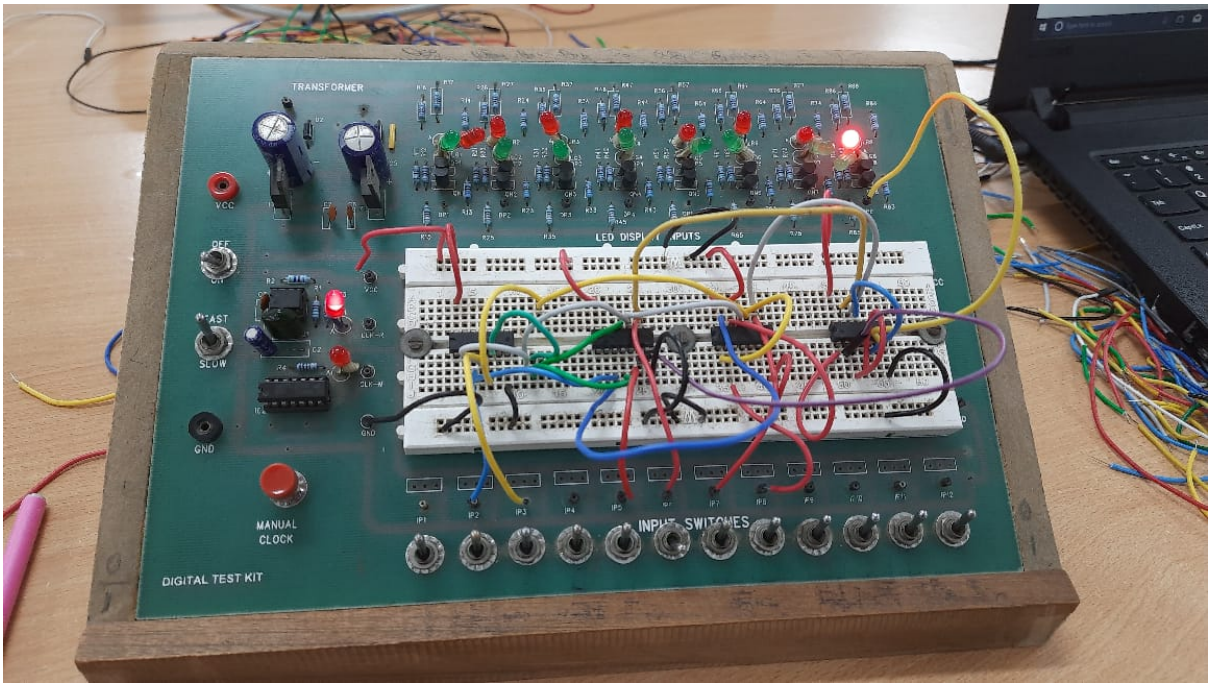
2. Circuit Diagram

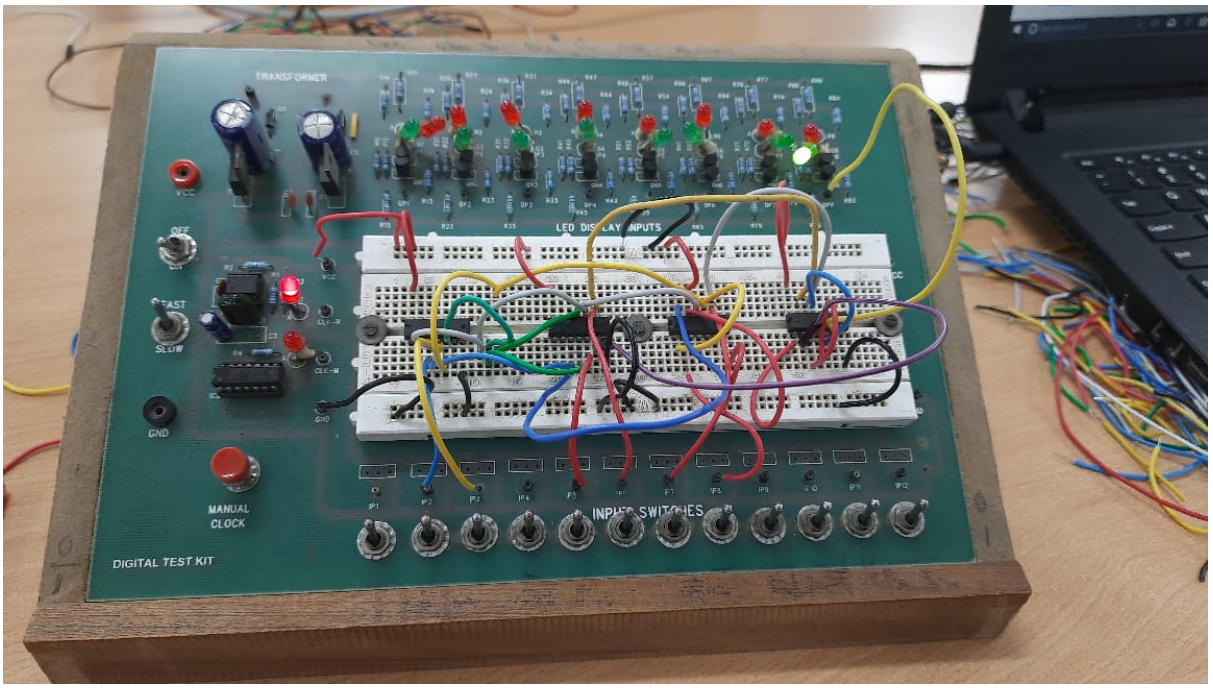


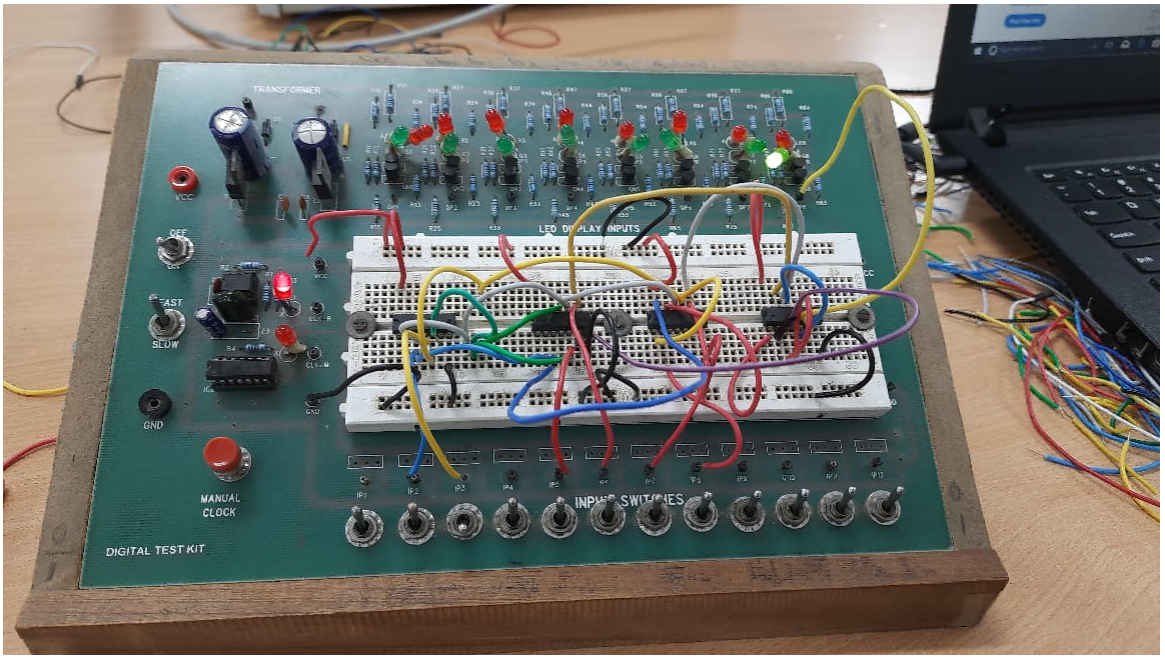

## Procedure:

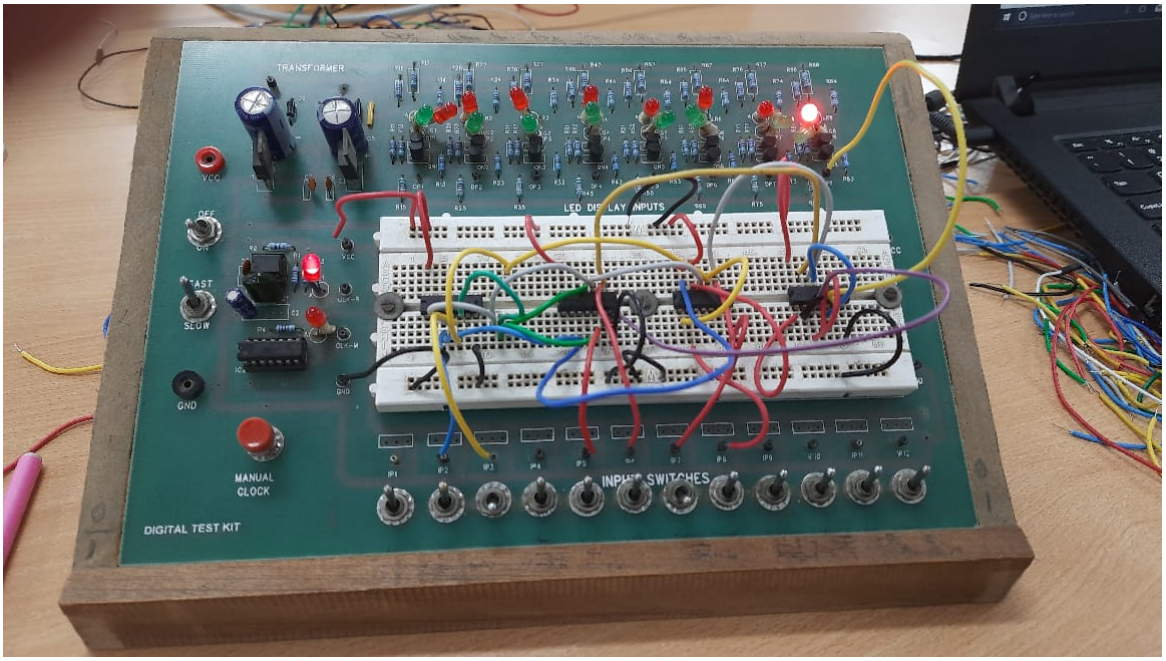
1. Employ NOT gates to generate the complement signals of $S_1$ and $S_0$, resulting in $S_1'$ and $S_0'$, respectively.
2. Incorporate these four signals, namely $S_1$, $S_0$, $S_1'$, and $S_0'$, into their respective gates according to the reference circuit diagram.
3. Upon constructing the circuit, give various combinations of inputs to govern the multiplexer's functionality, specifying how it selects and routes input data.
4. Verify the circuit's correctness by observing when the LED illuminates, ensuring it aligns with the expected outcomes dictated by the multiplexer's truth table.

## Observations:






1. The following Truth Table was noted down

| $S_1$ | $S_0$ | Output |
|---|---|---|
| 0 | 0 | $I_0$ |
| 0 | 1 | $I_1$ |
| 1 | 0 | $I_2$ |
| 1 | 1 | $I_3$ |

2. When both $S_1$ and $S_0$ are simultaneously set to 0, the multiplexer operates in a specific manner, routing the input signal as dictated by i0. For all other combinations of $S_1$ and $S_0$, the multiplexer follows the prescribed truth table, ensuring that the appropriate input is selected and forwarded to the output based on the given control signals.

## Conclusions:

We have created a 4-to-1 Multiplexer using basic logic gates, obtained its truth table and its output formula.

## Link for Tinkercad Simulation:

https://www.tinkercad.com/things/l54MBNHik97-3a-multiplexer-mux/editel?sharecode=bnaN0E-jCgF4Y3FQZbCj11-ybggoOQLx5IqP0HwvXGk

# Experiment 3 (Part B) - Demultiplexer [DEMUX] using Basic Logic Gates

## Objective:

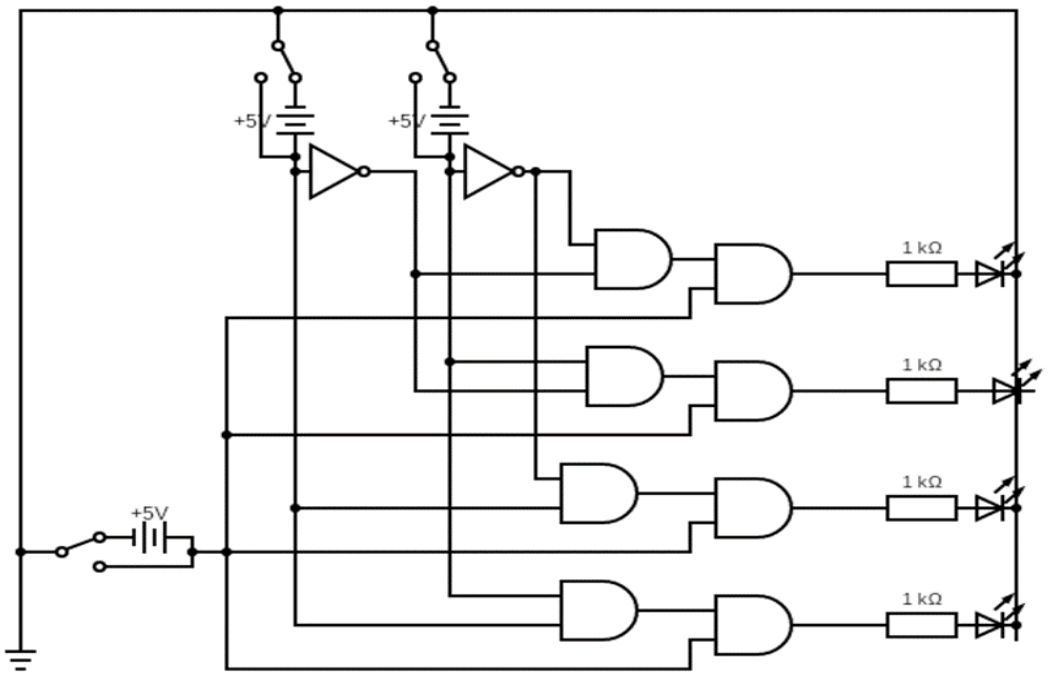
To design and build a Demultiplexer using basic logic gates.

## Electronic Components Required:

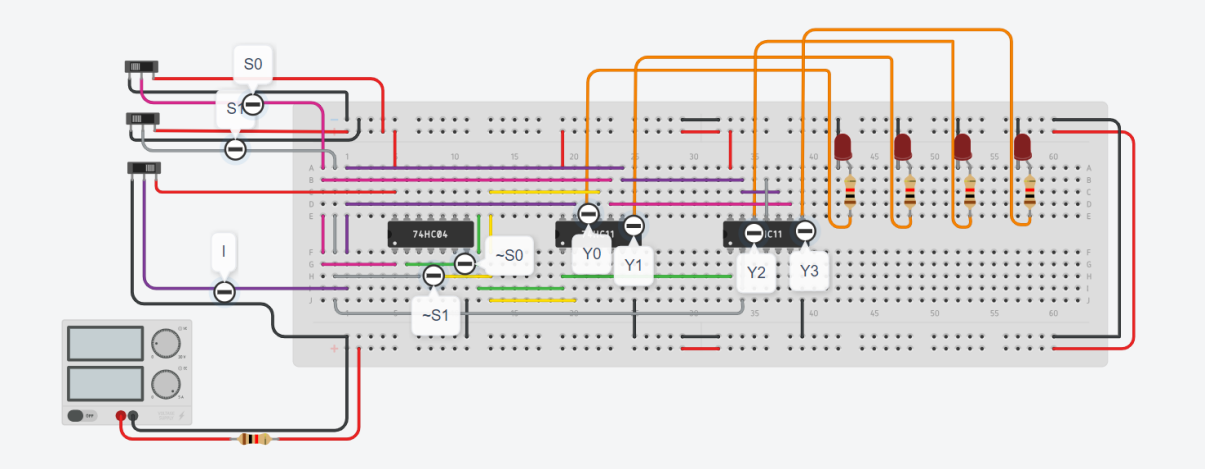
1. 74HC04 IC NOT Gate
2. 74HC11 IC Triple Input AND Gate
3. Normal Wires
4. Digital Test Kit
5. Voltage Supply

## Reference Circuit:

1. Circuit Diagram



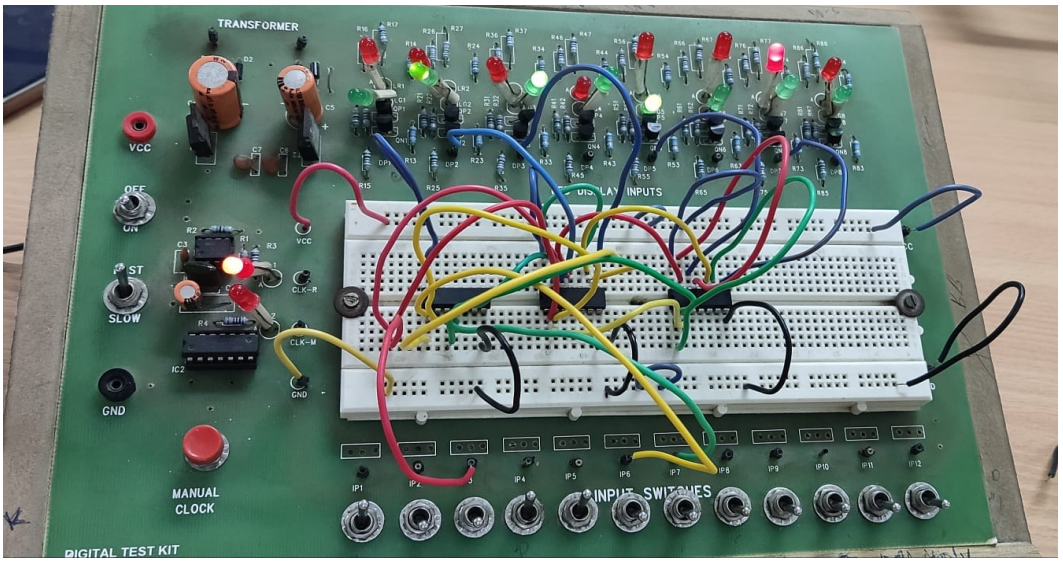
2. Tinkercad Screenshot

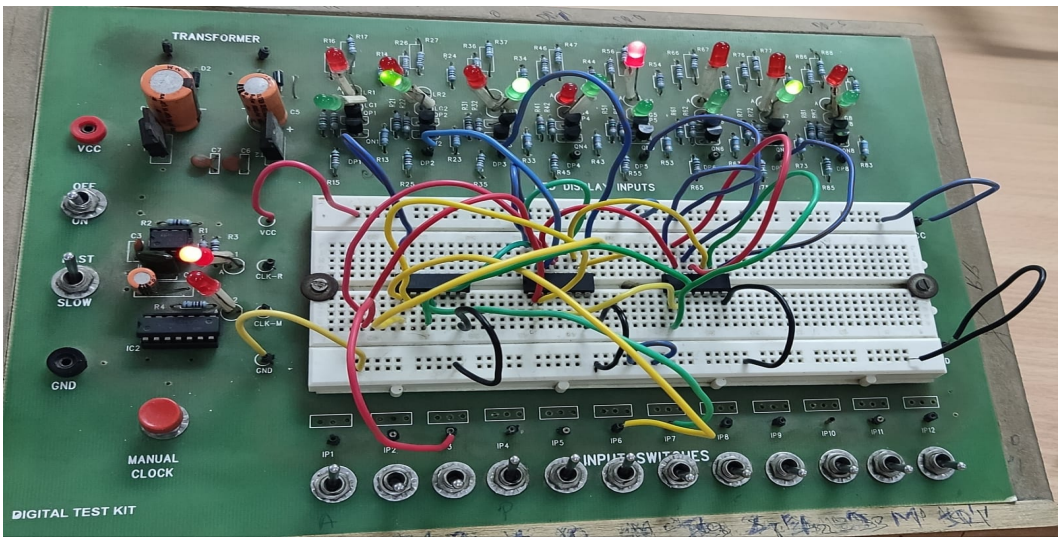


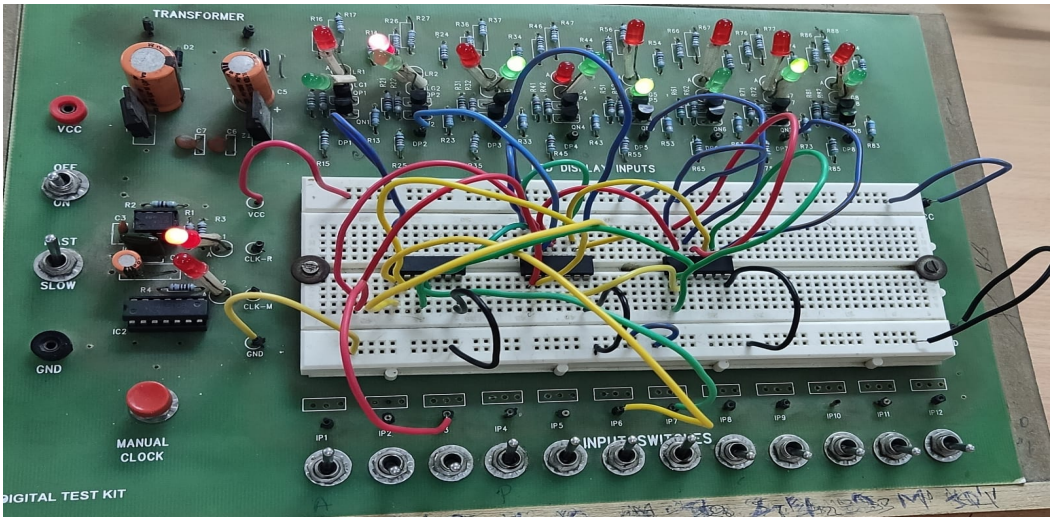

## Procedure:

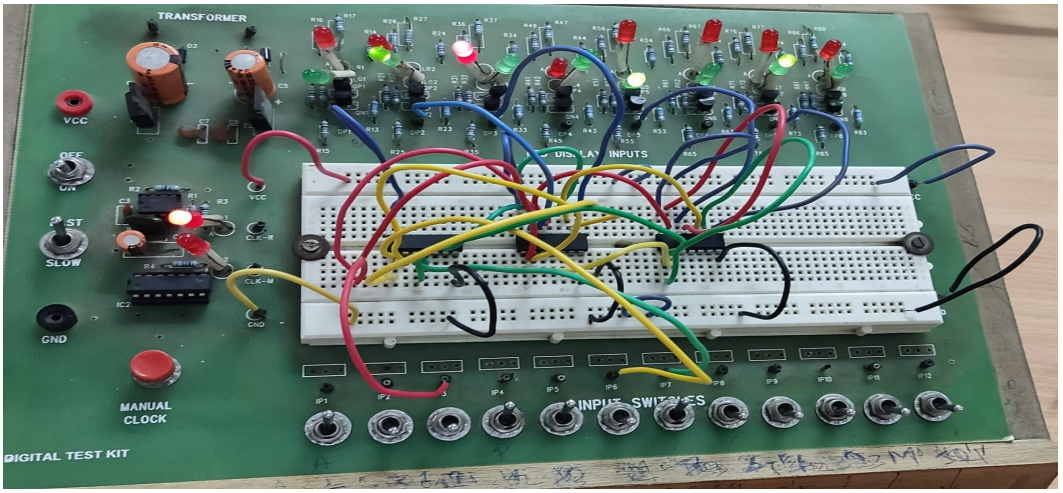
1. Connect $S_1$ and $S_0$ from the switches to the NOT Gate. The outputs of this gate gives us S1' and S0'
2. Connect $S_1$, $S_0$, $S_1$' and $S_0$' to appropriate inputs and complete the circuit based on the given reference circuit.
3. Try out all possible combinations of inputs for the demultiplexer and then note down the resulting truth table.

## Observations:




TRANSFORMER
VCC
SLOW
GND
MANUAL
CLOCK
INPUTS
DIGITAL TEST KIT


TRANSFORMER
VCC
SLOW
GND
MANUAL
CLOCK
INPUTS
DIGITAL TEST KIT


TRANSFORMER
VCC
SLOW
GND
MANUAL
CLOCK
INPUTS
DIGITAL TEST KIT

1. We obtain the following truth table:

| $S_1$ | $S_0$ | $I_0$ | $I_1$ | $I_2$ | $I_3$ |
|---|---|---|---|---|---|
| 0 | 0 | Input | 0 | 0 | 0 |
| 0 | 1 | 0 | Input | 0 | 0 |
| 1 | 0 | 0 | 0 | Input | 0 |
| 1 | 1 | 0 | 0 | 0 | Input |

2. We see that the LED connected to $I_0$ glows when $S_0$ and $S_1$ is equal to 0 and input is 1, this can be further observed for all other combinations of $S_1$ and $S_0$.

## Conclusions:

Matching the truth table of the circuit with the truth table of a demultiplexer asserts that our experiment worked as intended and yielded the expected results.

## Link for Tinkercad Simulation:

https://www.tinkercad.com/things/fsyApkcgqtF-3b-de-multiplexer-dmux/editel?sharecode=cU-TxM10Lou95sl7S3oXSPj_YnrC-i6NNfwT2wVQAD8

# Experiment 3 (Part C) - Assemble and test circuits designed in Parts A and B [MUX + DEMUX]

## Objective:

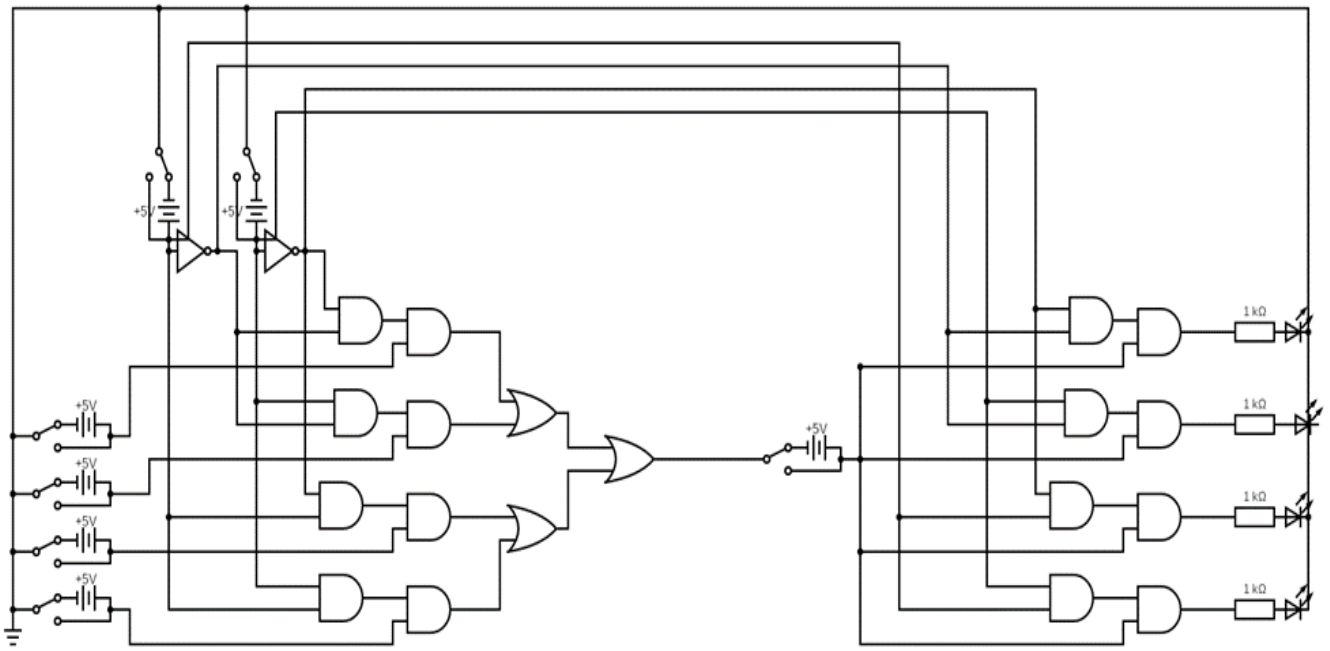
To connect the circuits made in the previous experiments such that the output from the multiplexer acts as input to the demultiplexer.

## Electronic Components Required:

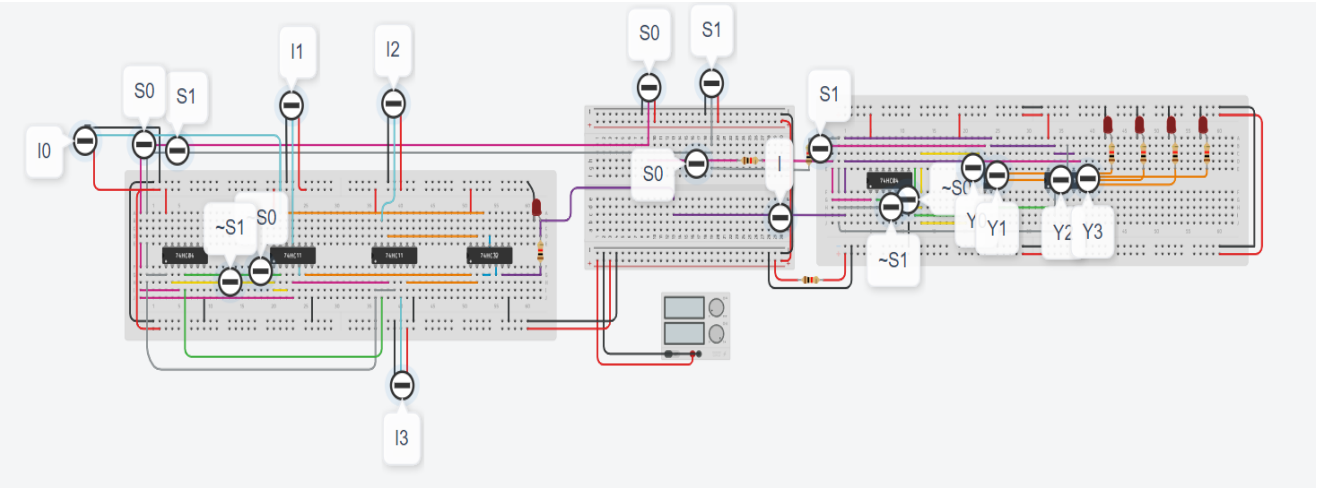
1. 74153 IC Multiplexer
2. 74139 IC Demultiplexer
3. Digital Test Kit
4. Normal Wires
5. Voltage Supply

## Reference Circuit:

1. Circuit Diagram



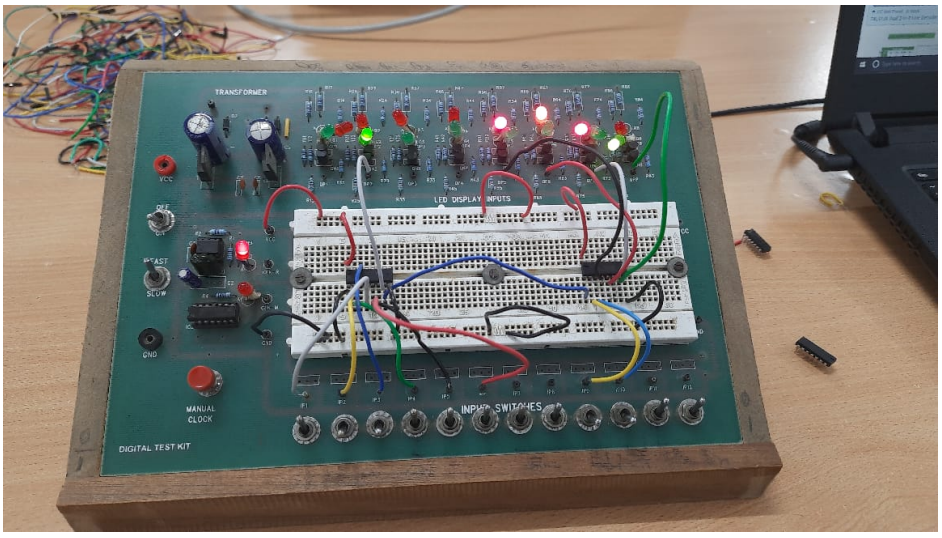
2. Tinkercad Screenshot




## Procedure:

1. Take the output from the MUX ic and connect it as input to the DEMUX IC as input
2. Now connect the inputs $I_0$, $I_1$, $I_2$ and $I_3$ to the MUX IC and connect the outputs of DEMUX $Y_0$, $Y_1$, $Y_2$ and $Y_3$ to the display LEDs.
3. Input all the possible combinations of values through the switches and note down the resulting truth table.

## Observations:



1. We observe the following truth table:

| $S_1$ | $S_0$ | $I_0$ | $I_1$ | $I_2$ | $I_3$ |
|---|---|---|---|---|---|
| 0 | 0 | Switch 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | Switch 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | Switch 2 | 0 |
| 1 | 1 | 0 | 0 | 0 | Switch 3 |

2. We observe that the LED connected to $Y_0$ only works as per $I_0$ when $S_1$ and $S_0$ is equal to 0, this is also observed with other combinations of $S_1$ and $S_0$ values.

## Conclusions:

As the values in the truth table observed from the circuit are equal to expected values, we can conclude the above circuits work.

## Link for Tinkercad Simulation:

https://www.tinkercad.com/things/4AReRdQzt09-3c-mux-dmux/editel?sharecode=zlwipTmIeQoNAJ97EARc9Kb3VmJITK2kPMn2bj_QVxk