AIM

To design implement gate level multiplexers and MSI multiplexers.

Software Required

Proteus Software

Theory

❖ What is MUX and DEMUX:

A multiplexer/Encoder (MUX) is a selector device that has 2i data inputs, and i select inputs. The value on the output of such a device is the value nth data input, where n is the binary number on the select inputs.

A demultiplexer/Decoder (DEMUX) is a selector device that has some i select inputs and 2i outputs. Interpreting the inputs as an i bit binary number, n, the decoder will make its nth output line TRUE, and all the FALSE. These devices often have one (or more) enable inputs.

❖ Applications of Multiplexer(MUX):

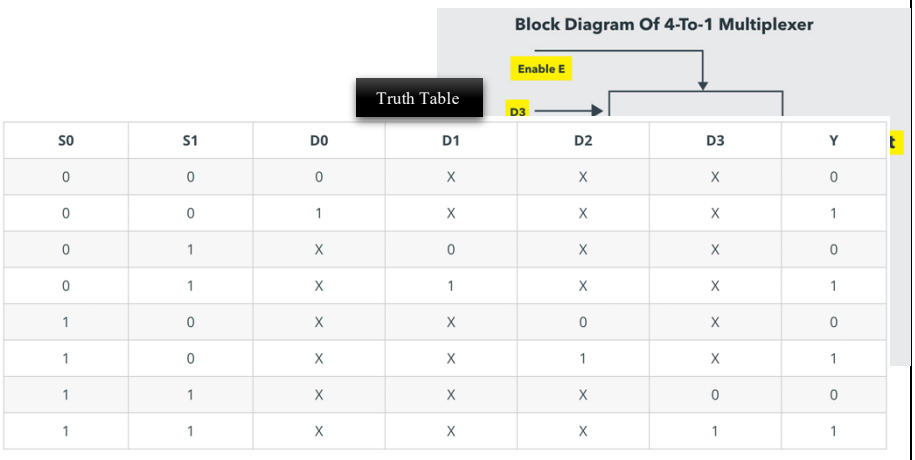
Multiplexer are used in various fields where multiple data need to be transmitted using a single line. Following are some of the applications of multiplexers –

1. **Communication System** – Communication system is a set of system that enable communication like transmission system, relay and tributary station, and communication network. The efficiency of communication system can be increased considerably using multiplexer. Multiplexer allow the process of transmitting different type of data such as audio, video at the same time using a single transmission line.
2. **Telephone Network** – In telephone network, multiple audio signals are integrated on a single line for transmission with the help of multiplexers. In this way, multiple audio signals can be isolated and eventually, the desire audio signals reach the intended recipients.
3. **Computer Memory** – Multiplexers are used to implement huge amount of memory into the computer, at the same time reduces the number of copper lines required to connect the memory to other parts of the computer circuit.
4. **Transmission from the Computer System of a Satellite** – Multiplexer can be used for the transmission of data signals from the computer system of a satellite or spacecraft to the ground system using the GPS (Global Positioning System) satellites.

❖ Applications of Demultiplexer(DEMUX):

1. Demultiplexer is used to connect a single source to multiple destinations. The main application area of demultiplexer is communication system, where multiplexers are used. Most of the communication system are bidirectional i.e., they function in both ways (transmitting and receiving signals). Hence, for most of the applications, the multiplexer and demultiplexer work in sync. Demultiplexer are also used for reconstruction of parallel data and ALU circuits.
2. **Communication System** – Communication system use multiplexer to carry multiple data like audio, video and other form of data using a single line for transmission. This process make the transmission easier. The demultiplexer receive the output signals of the multiplexer and converts them back to the original form of the data at the receiving end. The multiplexer and demultiplexer work together to carry out the process of transmission and reception of data in communication system.
3. **ALU (Arithmetic Logic Unit)** – In an ALU circuit, the output of ALU can be stored in multiple registers or storage units with the help of demultiplexer. The output of ALU is fed as the data input to the demultiplexer. Each output of demultiplexer is connected to multiple register which can be stored in the registers.
4. **Serial to Parallel Converter** – A serial to parallel converter is used for reconstructing parallel data from incoming serial data stream. In this technique, serial data from the incoming serial data stream is given as data input to the demultiplexer at the regular intervals. A counter is attach to the control input of the demultiplexer. This counter directs the data signal to the output of the demultiplexer where these data signals are stored. When all data signals have been stored, the output of the demultiplexer can be retrieved and read out in parallel.

❖ 4-to-1 MUX:



Truth Table

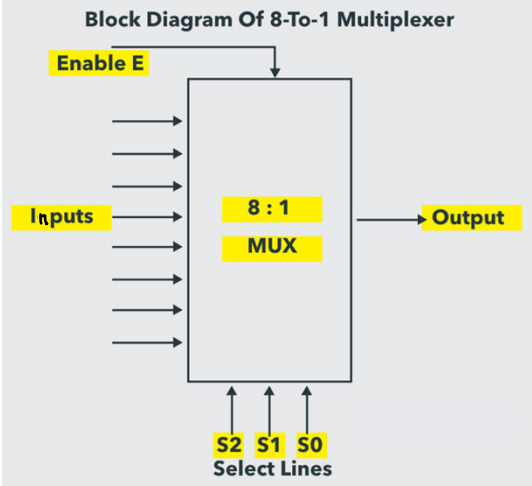
S0	S1	D0	D1	D2	D3	Y
0	0	0	X	X	X	0
0	0	1	X	X	X	1
0	1	X	0	X	X	0
0	1	X	1	X	X	1
1	0	X	X	0	X	0
1	0	X	X	1	X	1
1	1	X	X	X	0	0
1	1	X	X	X	1	1

A 4-to-1 multiplexer consists four data input lines as D0 to D3, two select lines as S0 and S1 and a single output line Y. The select lines S0 and S1 select one of the four input lines to connect the output line. The figure below shows the block diagram of a 4-to-1 multiplexer in which, the multiplexer decodes the input through select line.

The truth table of a 4-to-1 multiplexer is shown below in which four input combinations 00, 10, 01 and 11 on the select lines respectively switches the inputs D0, D2, D1 and D3 to the output. That means when S0=0 and S1 =0, the output at Y is D0, similarly Y is D1 if the select inputs S0=0 and S1= 1 and so on.

❖ 8-to-1 MUX:

An 8-to-1 multiplexer consists of eight data inputs D0 through D7, three input select lines S0 through S2 and a single output line Y. Depending on the select lines combinations, multiplexer selects the inputs.
The figure shows the block diagram of an 8-to-1 multiplexer with enable input that can enable or disable the multiplexer. Since the number data bits given to the MUX are eight, then 3 bits (23 = 8) are needed to select one of the eight data bits.



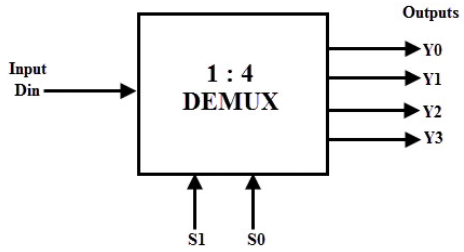
Truth Table

S0	S1	S2	D0	D1	D2	D3	D4	D5	D6	D7	Y
0	0	0	0	X	X	X	X	X	X	X	0
0	0	0	1	X	X	X	X	X	X	X	1
0	0	1	X	0	X	X	X	X	X	X	0
0	0	1	X	1	X	X	X	X	X	X	1
0	1	0	X	X	0	X	X	X	X	X	0
0	1	0	X	X	1	X	X	X	X	X	1
0	1	1	X	X	X	0	X	X	X	X	0
0	1	1	X	X	X	1	X	X	X	X	1
1	0	0	X	X	X	X	0	X	X	X	0
1	0	0	X	X	X	X	1	X	X	X	1
1	0	1	X	X	X	X	X	0	X	X	0
1	0	1	X	X	X	X	X	1	X	X	1
1	1	0	X	X	X	X	X	X	0	X	0
1	1	0	X	X	X	X	X	X	1	X	1
1	1	1	X	X	X	X	X	X	X	0	0
1	1	1	X	X	X	X	X	X	X	1	1

❖ 1-to-4 DEMUX:

A 1-to-4 demultiplexer has a single input (D), two selection lines (S1 and S0) and four outputs (Y0 to Y3). The input data goes to any one of the four outputs at a given time for a particular combination of select lines. This demultiplexer is also called as a 2-to-4 Demultiplexer, which means that it has two select lines and 4 output lines. The truth table of this type of demultiplexer is given below. From the truth table it is clear that, when S0 = 0 and S1 = 0, the data input is connected to output Y0 and when S0 = 0 and s1=1, the data input is connected to output Y1. Similarly, other outputs are connected to the input for the other two combinations of select lines.

Block Diagram of 1 to 4 Demultiplexer



Truth Table

S1	S0	D	Y3	Y2	Y1	Y0
0	0	0	0	0	0	**0**
0	0	1	0	0	0	**1**
0	1	0	0	0	**0**	0
0	1	1	0	0	**1**	0
1	0	0	0	**0**	0	0
1	0	1	0	**1**	0	0
1	1	0	**0**	0	0	0
1	1	1	**1**	0	0	0

❖ Problem From R P Jain :

Q) Realise the logic function of the truth table given below:

Truth Table

Input				Output
A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
0	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Solution: We should convert this into 3 input and output depend on one input. So that we can use 8 to 1 Multiplexer.

Truth Table

Input				Output	
A	B	C	D	Y	
0	0	0	0	0	]-0
0	0	0	1	0	]-D'
0	0	1	0	1	]-D'
0	0	1	1	0	]-1
0	1	0	0	1	]-D
0	1	0	1	0	]-1
0	1	1	0	1	]-D'
0	1	1	1	1	]-D
0	0	0	0	0	
1	0	0	1	1	
1	0	1	0	1	
1	0	1	1	1	
1	1	0	0	1	
1	1	0	1	0	
1	1	1	0	0	
1	1	1	1	1	

Truth Table

Input			Output
A	B	C	Y
0	0	0	0
0	0	1	D'
0	1	0	D'
0	1	1	1
1	0	0	D
1	0	1	1
1	1	0	D'
1	1	1	D

Block Diagram

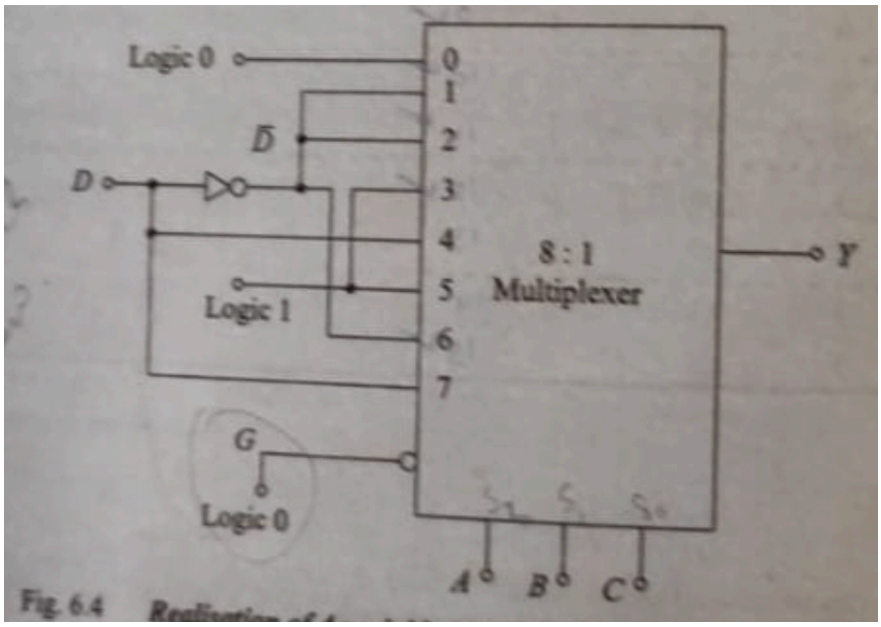


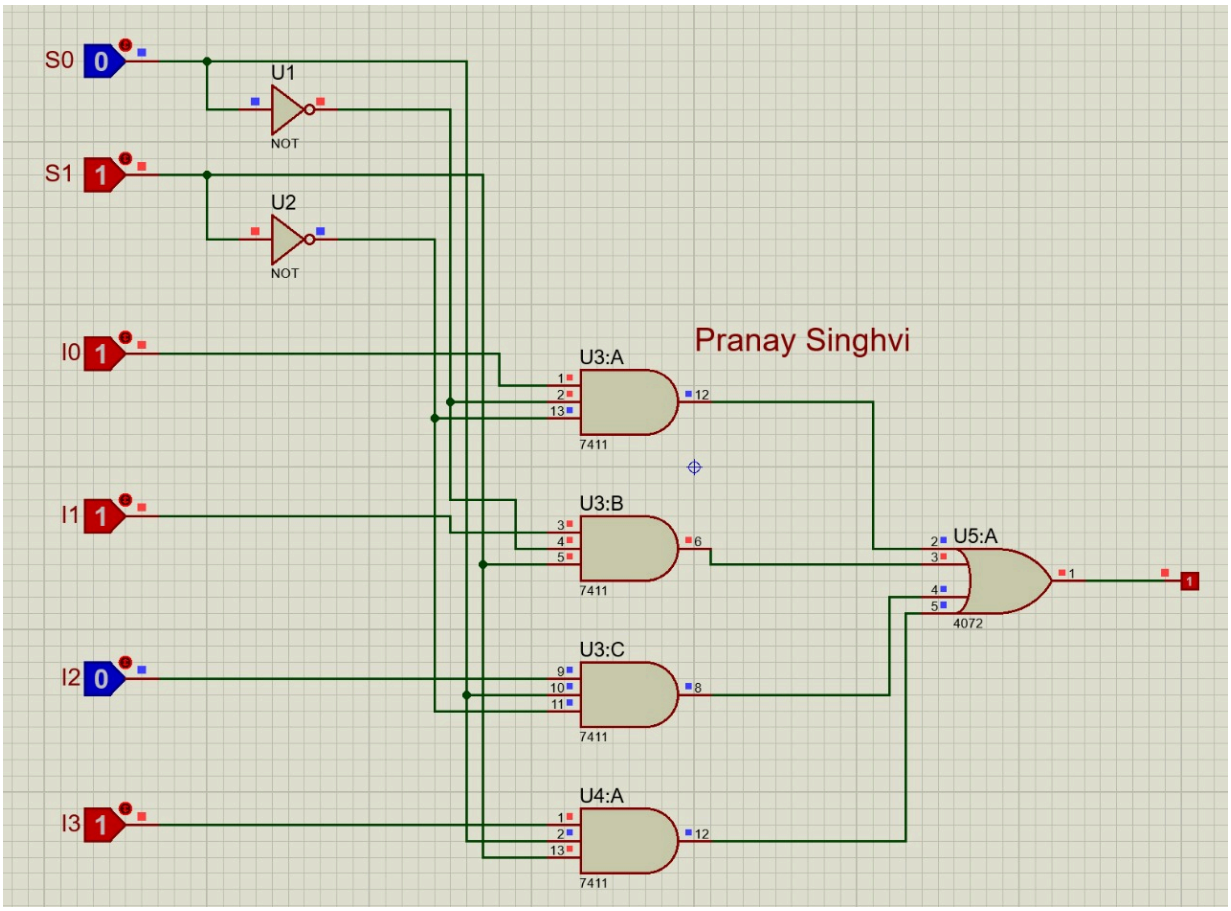
Fig. 6.4

Procedure

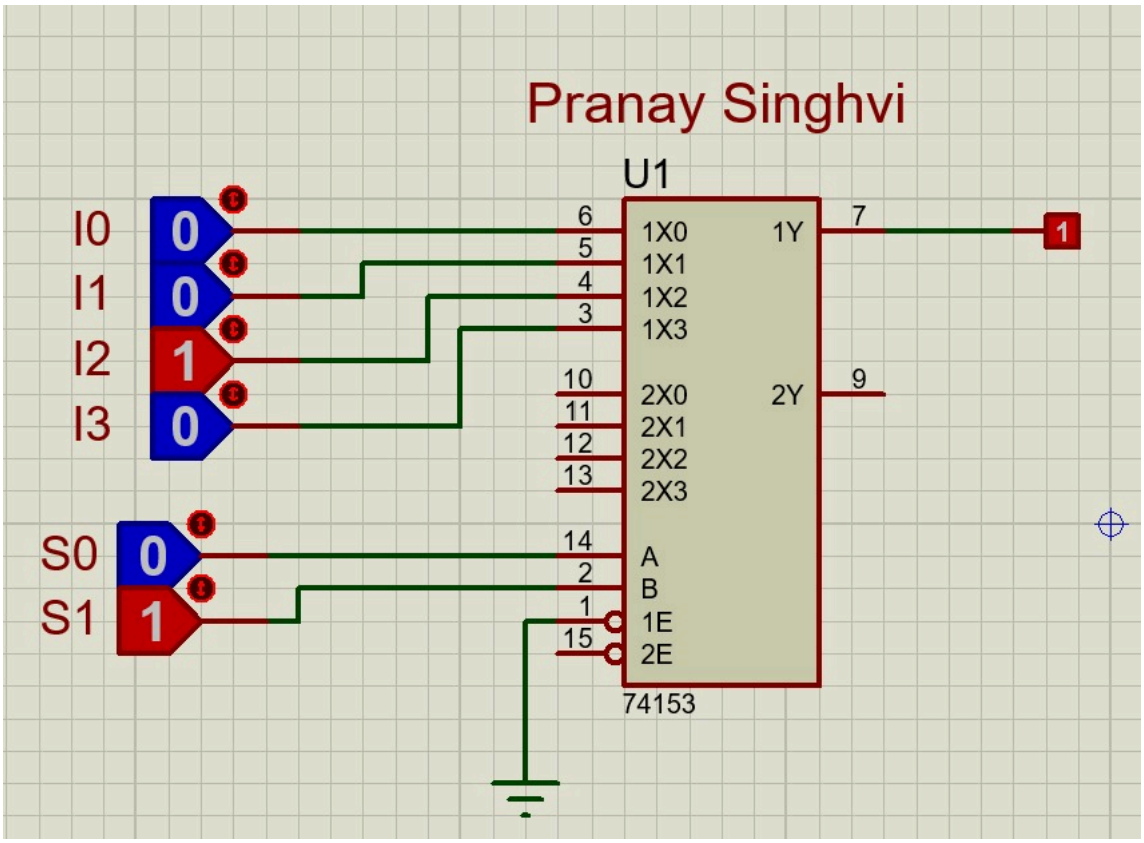
1) Open a new project in protecus
2) Click on Device from the left-side tools.
3) Choose the of required IC device and place in its places.
4) Connect all the device and set the binary digit .
5) Note the binary digit of output.
6) Then Run Stimulation.
7) Take a Screen shot of desired output .
8) Do different takes and take Screen shots of their output.

Results and Observations

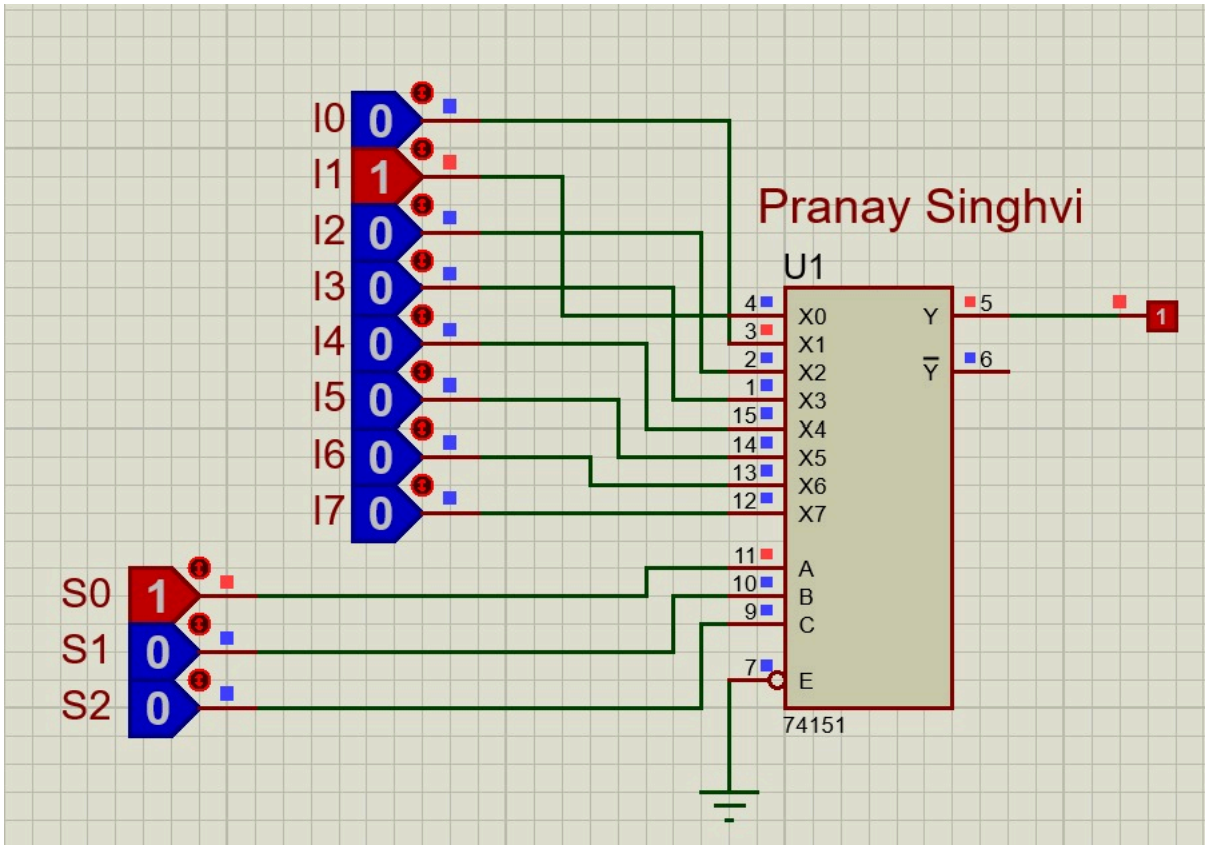
- **4:1 MUX using Gates**



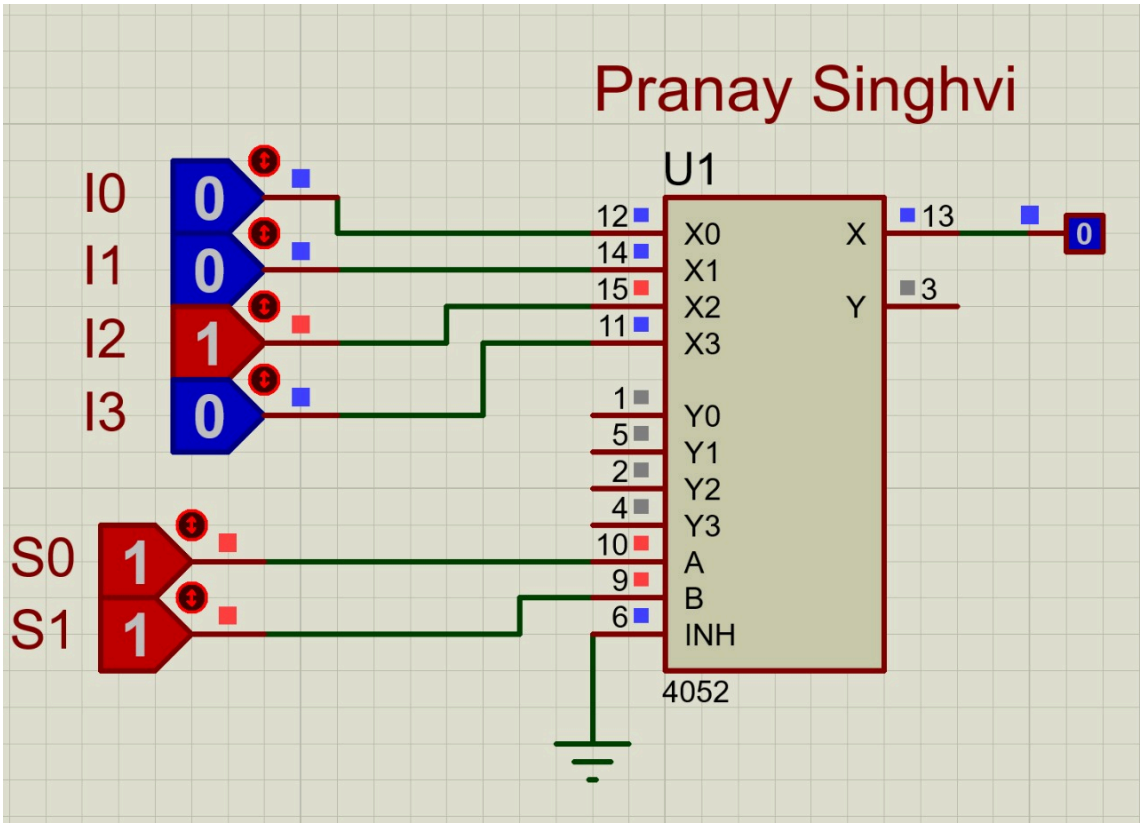
- **4:1 MUX using IC 74153**



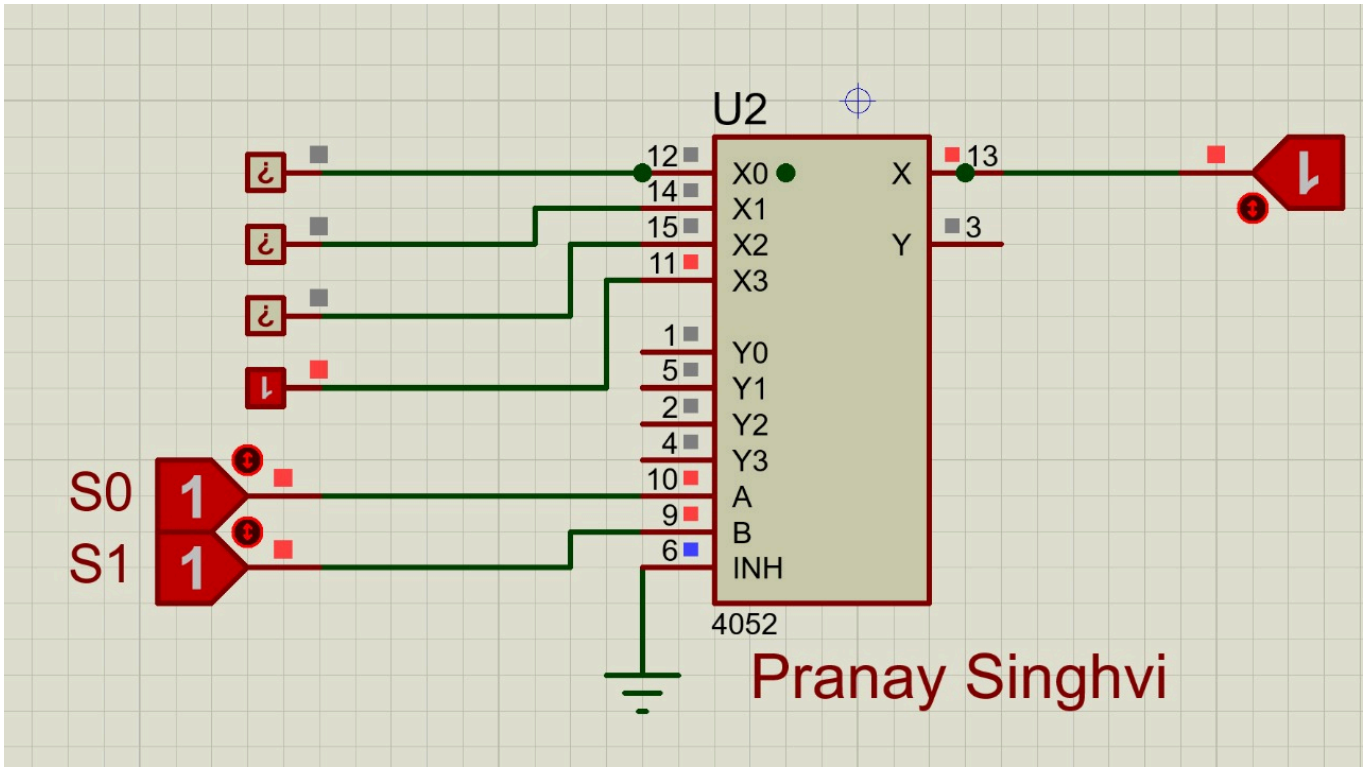
- **8:1 MUX using IC 74151**



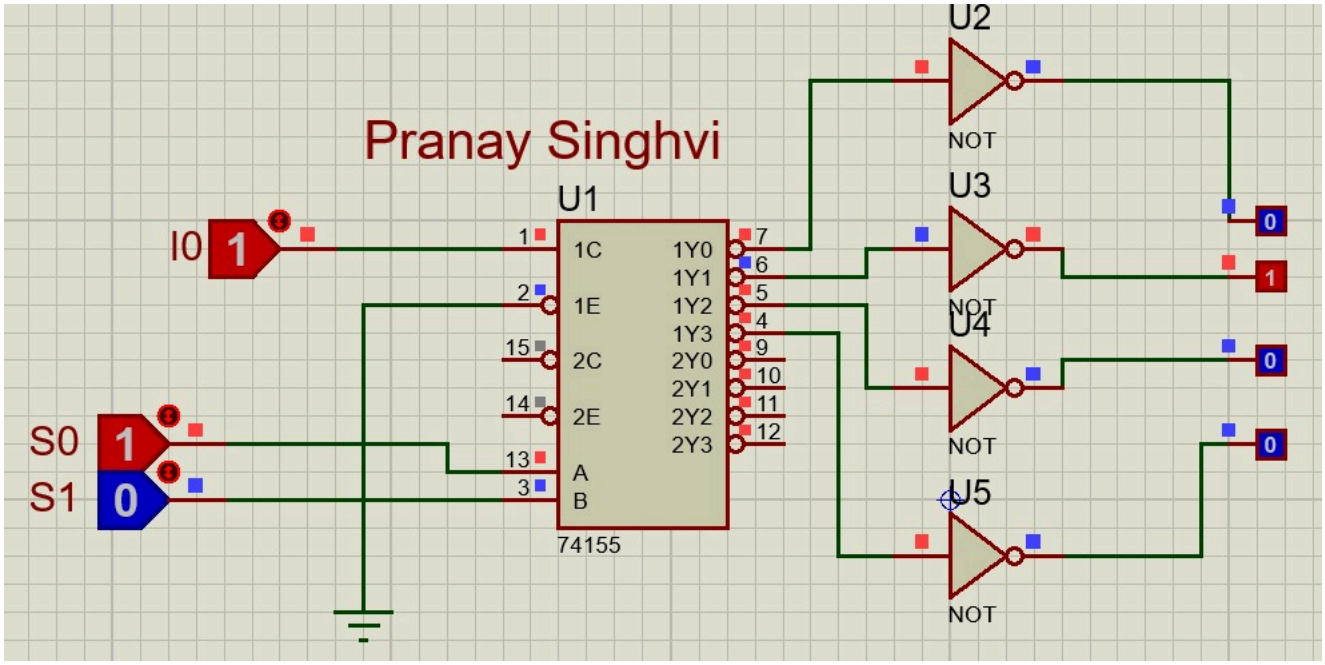
- **4:1 MUX using IC 4052**



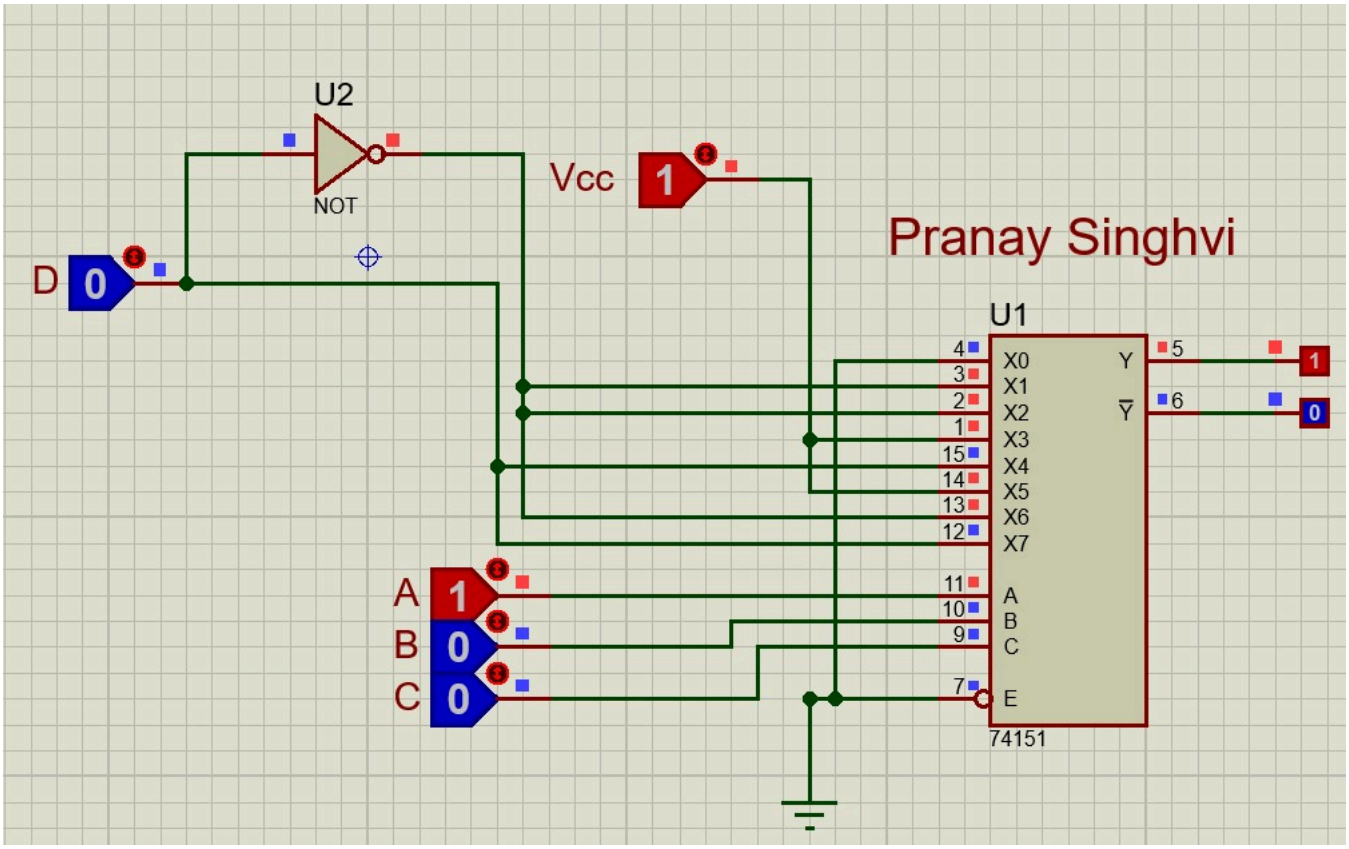
- **1:4 DEMUX using IC 4052**



- **1:4 DEMUX using IC 74155**



- **Problem from R P Jain and using IC 74151**



Conclusion

We Conclude that MUX(Multiplexer) can covert multiple input to single output & and DEMUX(demultiplexer) convert single input to multiple output.