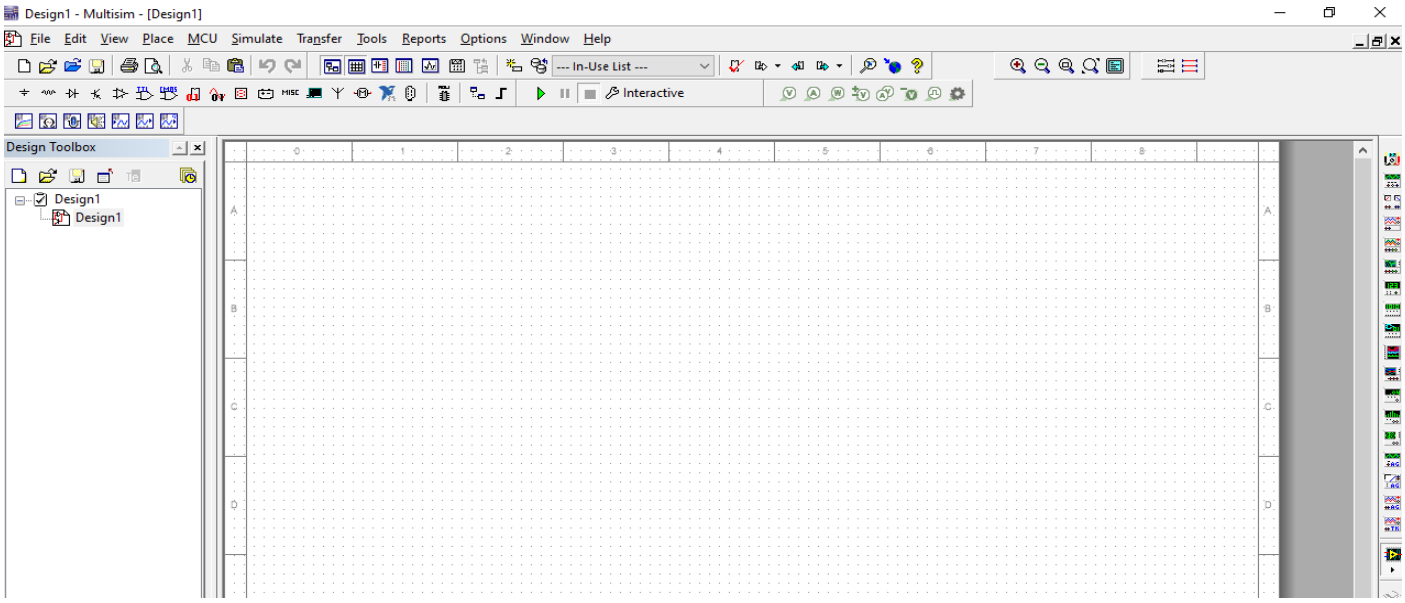
Experiment No. 1

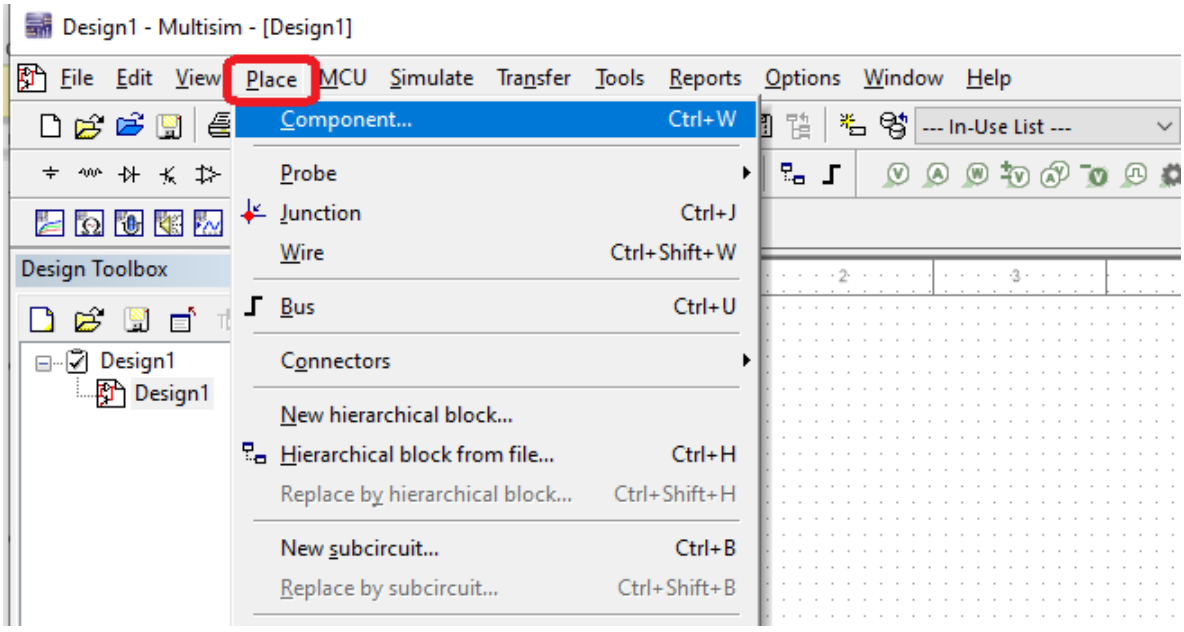
Familiarization of Multisim

Run 1: Understanding the Multisim14.1 Software

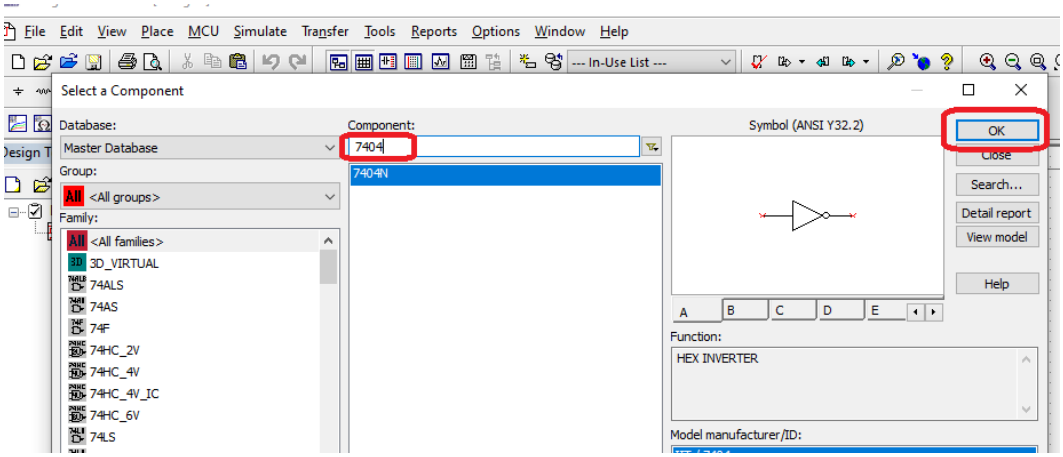
1. Open the Multisim14.1 Software by double clicking on 



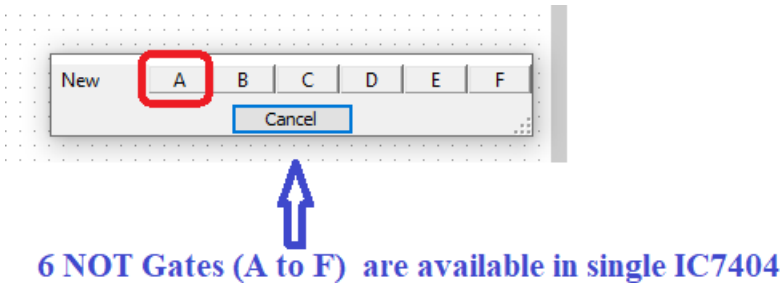
2. Goto Place->Components



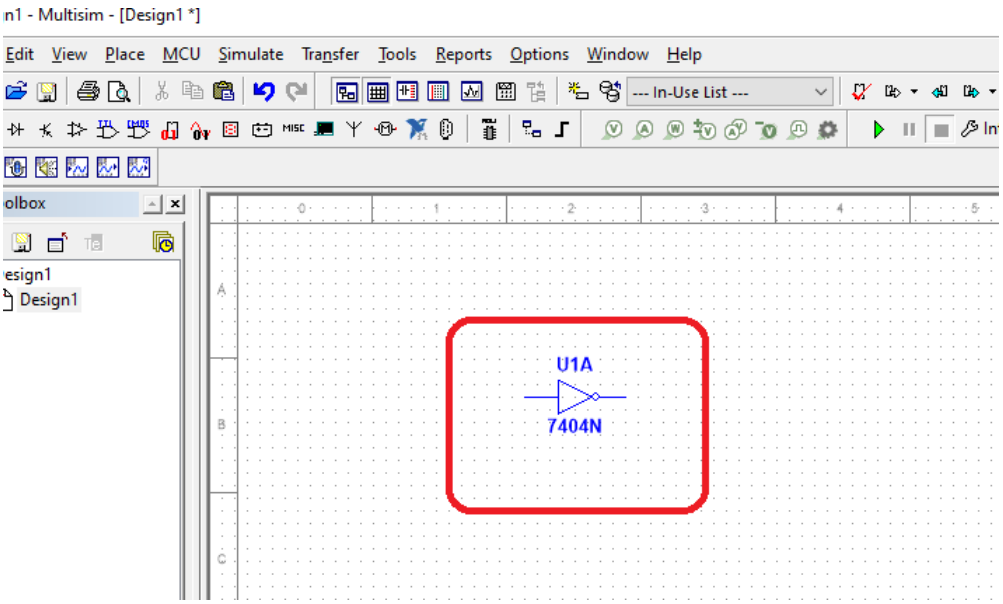
3. A new Component window will open, Search for IC7404 and select it,



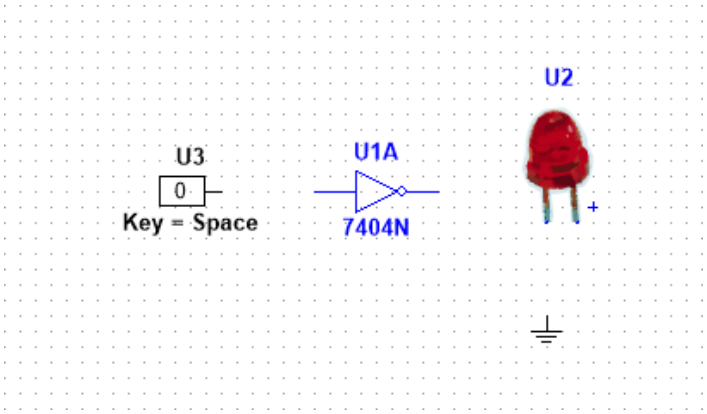
One more popup window will appear to select NOT Gate, Each IC 7404 having 6 Not Gates. Select first one.



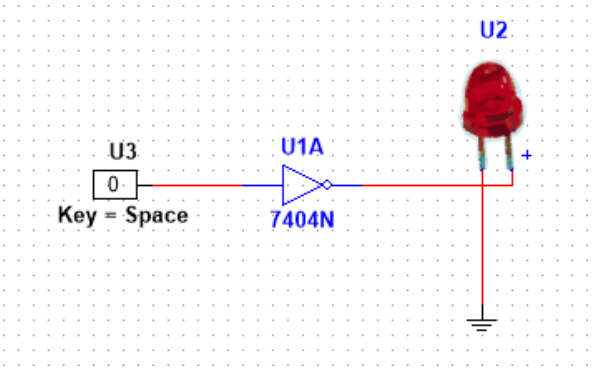
4. Now Paste the selected Not Gate by clicking inside the Design window and close the other windows



5. Similarly add three more components; Led1_Red , GROUND, INTERACTIVE_DIGITAL_CONSTANT

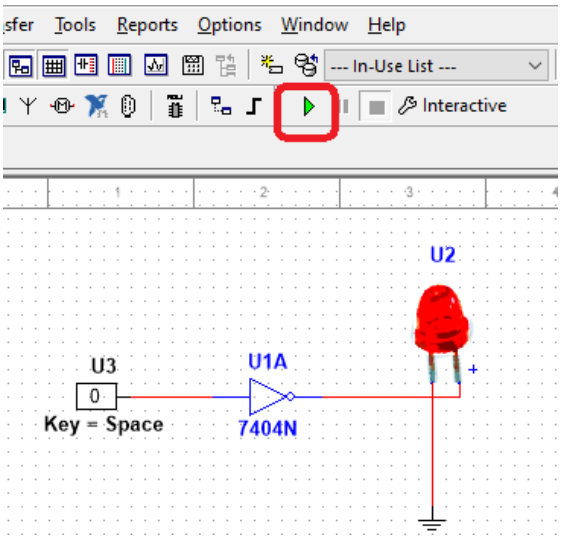


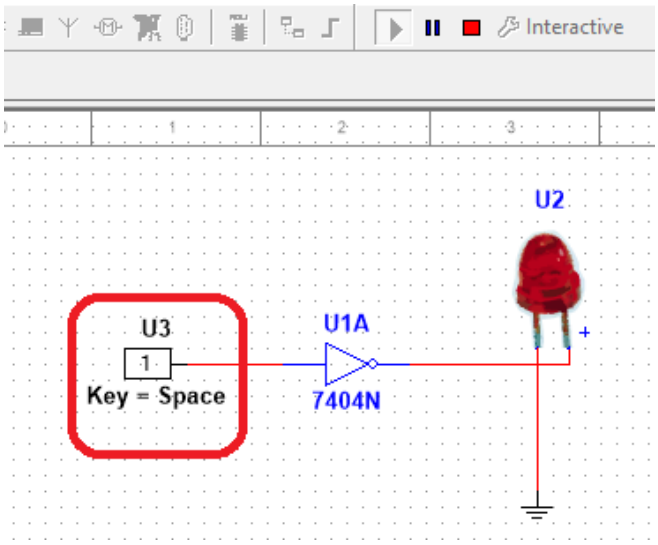
6. Now connect all these with the help of mouse



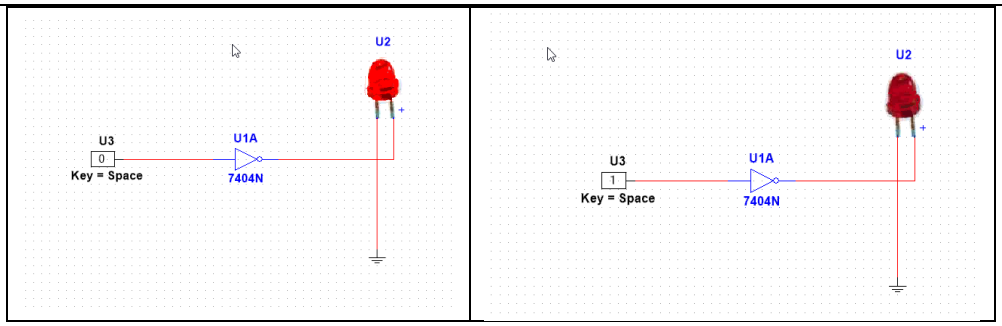
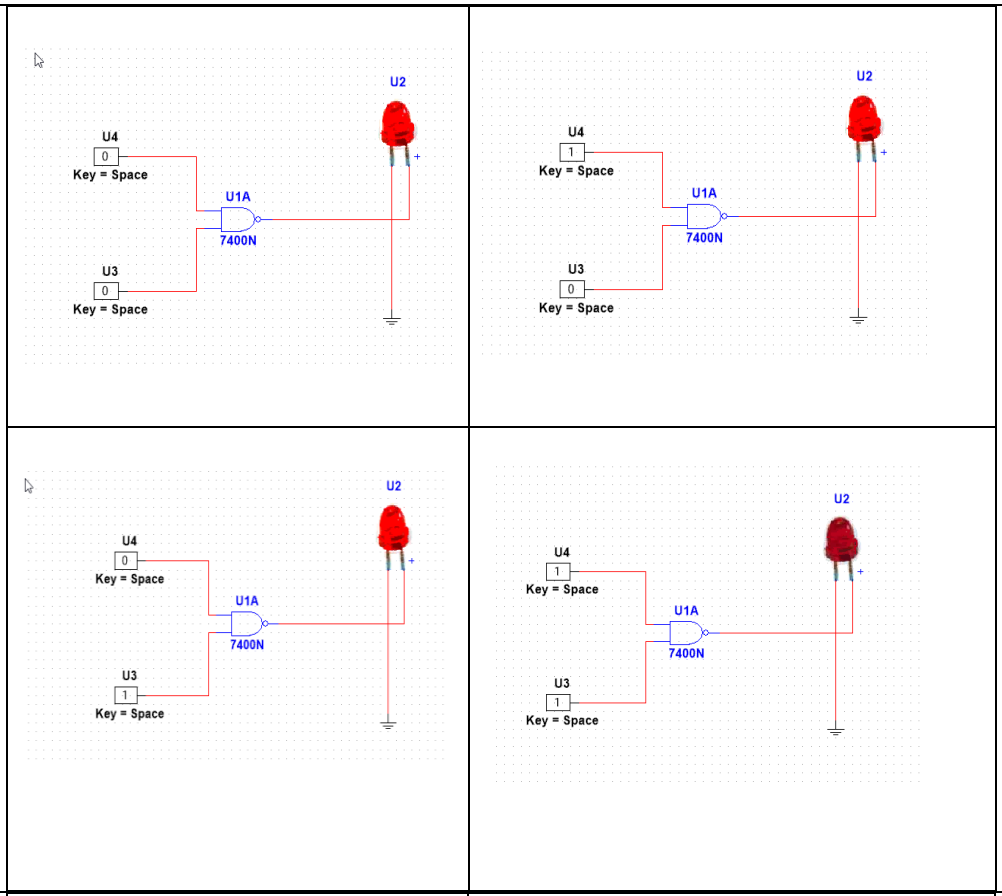
7. Run it by clicking on Play button or by F5, LED will glow because I/P is ‘Low’, Now makes it ‘High’ by clicking on

   Digital_Constant and observe the changes.





8. **Do the same for all gates (AND, NAND, OR, NOR, XOR, XNOR) and complete the truth table.**

<table>
<tr><th>GATE</th><th>IMAGES</th><th>TRUTH TABLE</th></tr>
<tr><td>NOT</td><td> 
</td><td>
<table>
<tr><th colspan="2" rowspan="2">INPUT
A</th><th rowspan="2">OUTPUT</th></tr>
<tr><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>NAND</td><td> 
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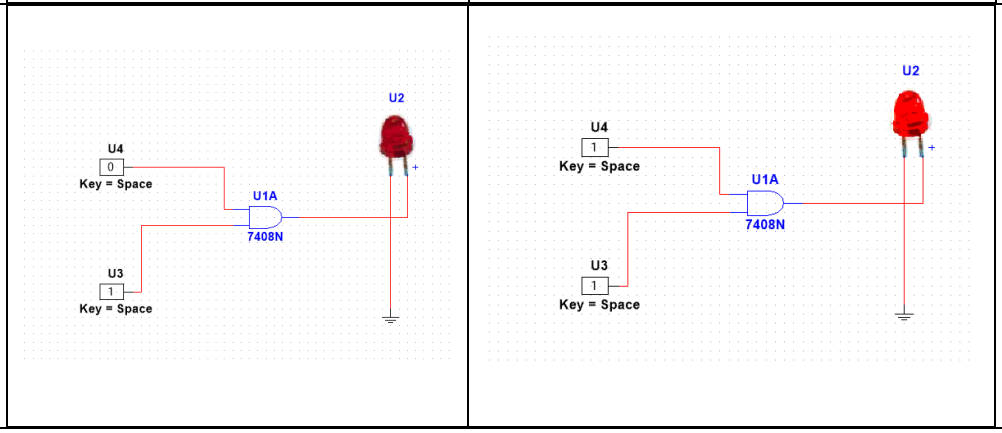
<table>
<tr><th colspan="2" rowspan="2">INPUT</th><th rowspan="2">OUTPUT</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>AND</td><td> 
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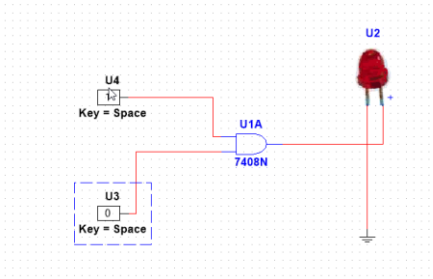
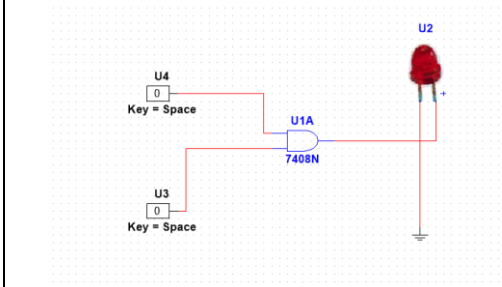
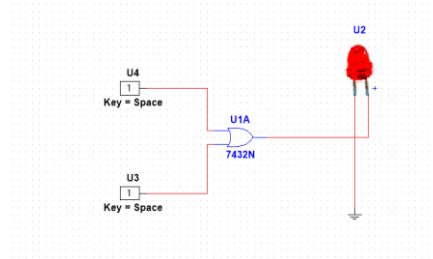
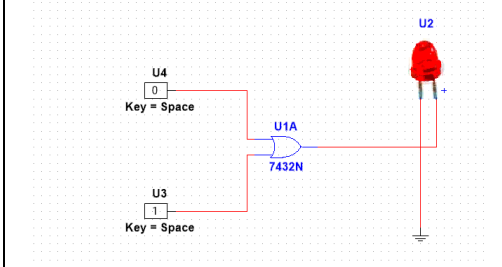
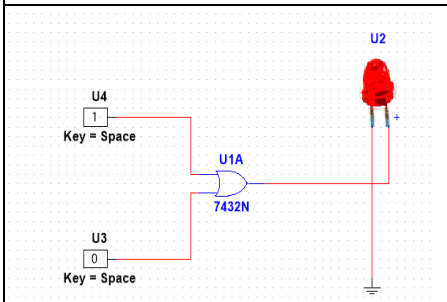
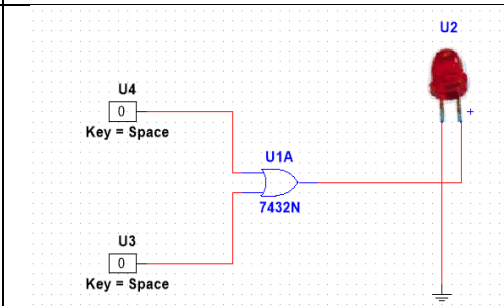
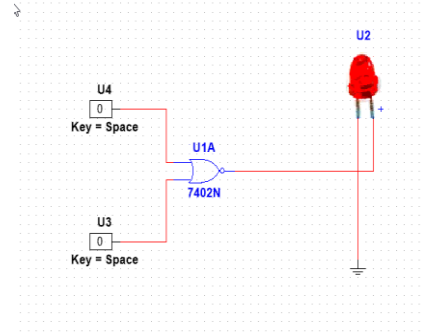
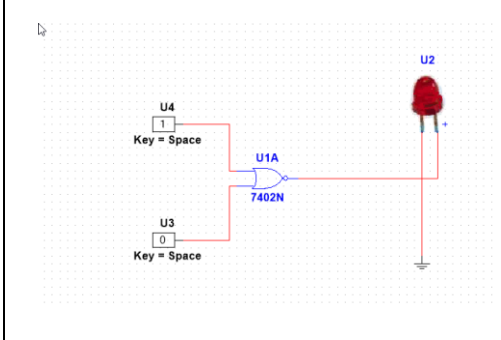
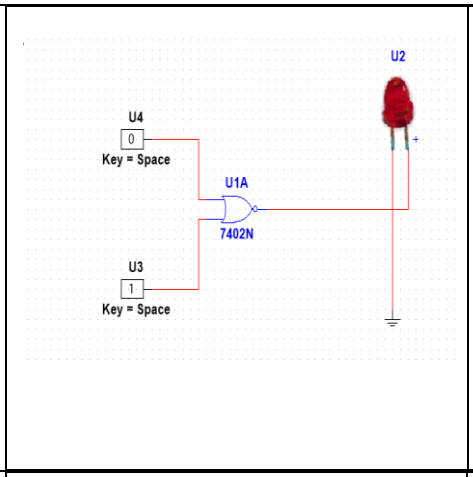
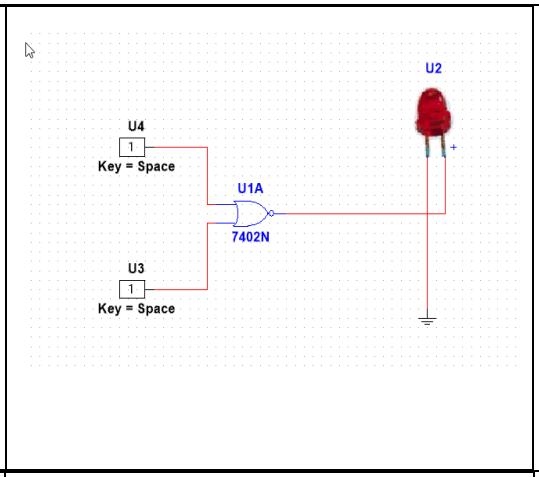
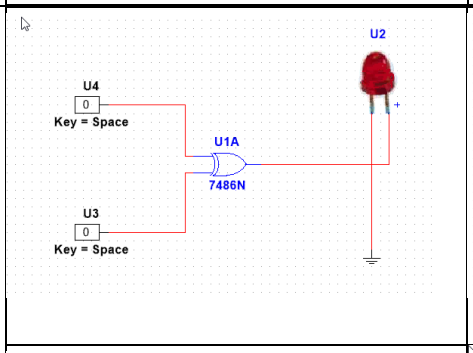
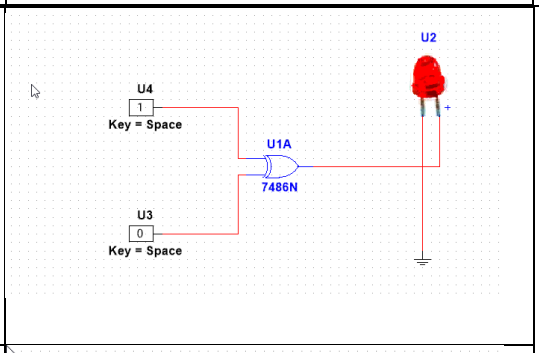
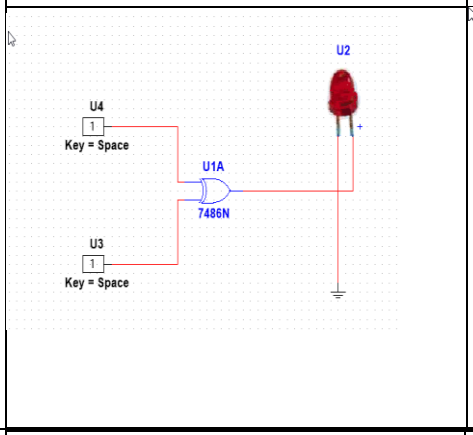
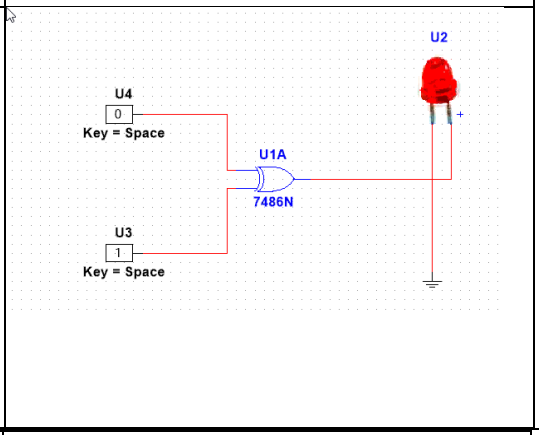
<table>
<tr><th colspan="2" rowspan="2">INPUT</th><th rowspan="2">OUTPUT</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table>
</td></tr>
</table>

				
OR				
				

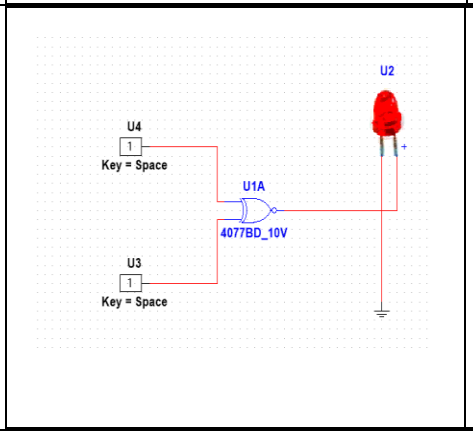
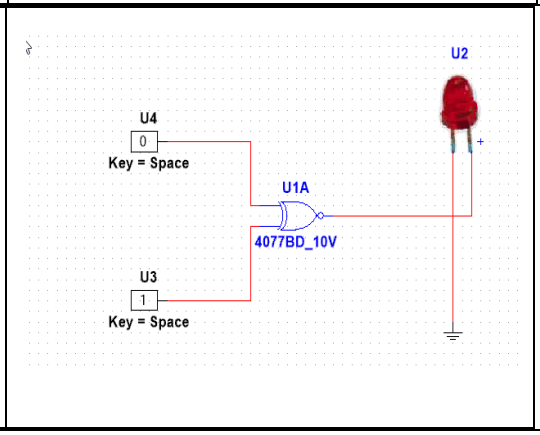
INPUT		OUTPUT
A	B	
0	0	0
1	0	1
0	1	1
1	1	1

NOR				

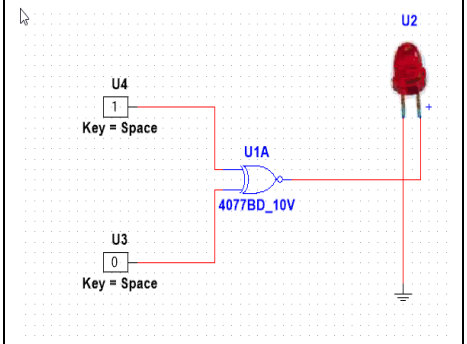
INPUT		OUTPUT
A	B	
0	0	1
1	0	0
0	1	0
1	1	0

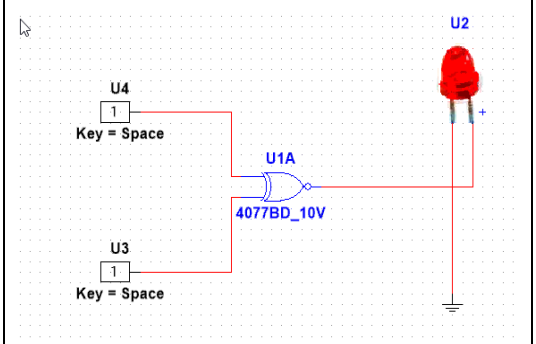
	 	
XOR	   	

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

XNOR	 	

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



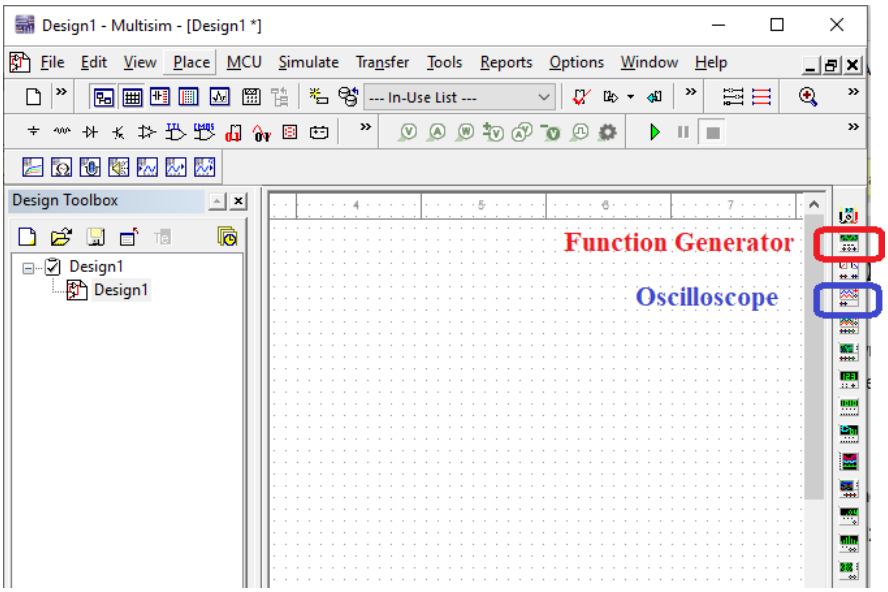


Q: Which power supply would you choose for digital IC based experiments? Why?
A: DC i.e., Direct Current is used for the power supply in IC based experiments. This is because digital circuitry works on specific voltage levels. Alternating voltage has infinite voltage levels, which is not easy to control. Also, noise in voltage/current signal is very difficult to filter. Direct voltage can be varied among specified values in a very controlled manner. This makes digital circuit to work more efficiently.

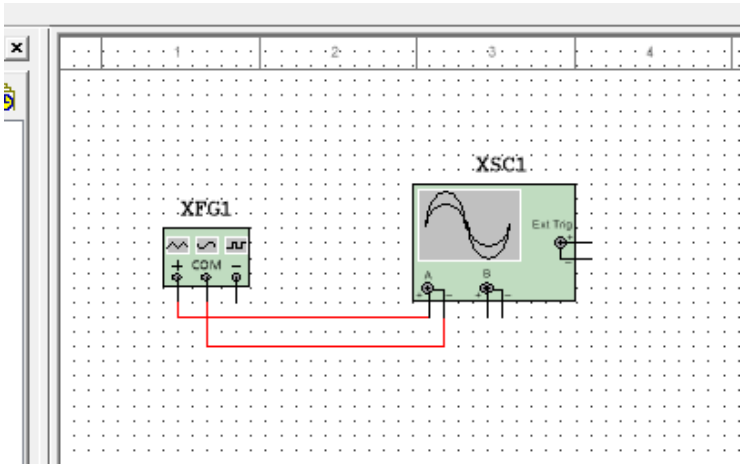
Run 2: Understanding the Oscilloscope and Function Generator

The Oscilloscope is the most useful and versatile electronic test equipment. It lets us see voltage in a circuit as afunction of time, triggering on a particular point of the waveform so that a stationary display result.

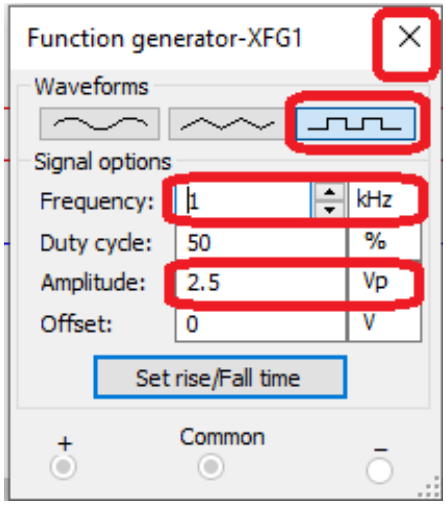
a. Add Function Generator and Oscilloscope from Right side panel of Multisim



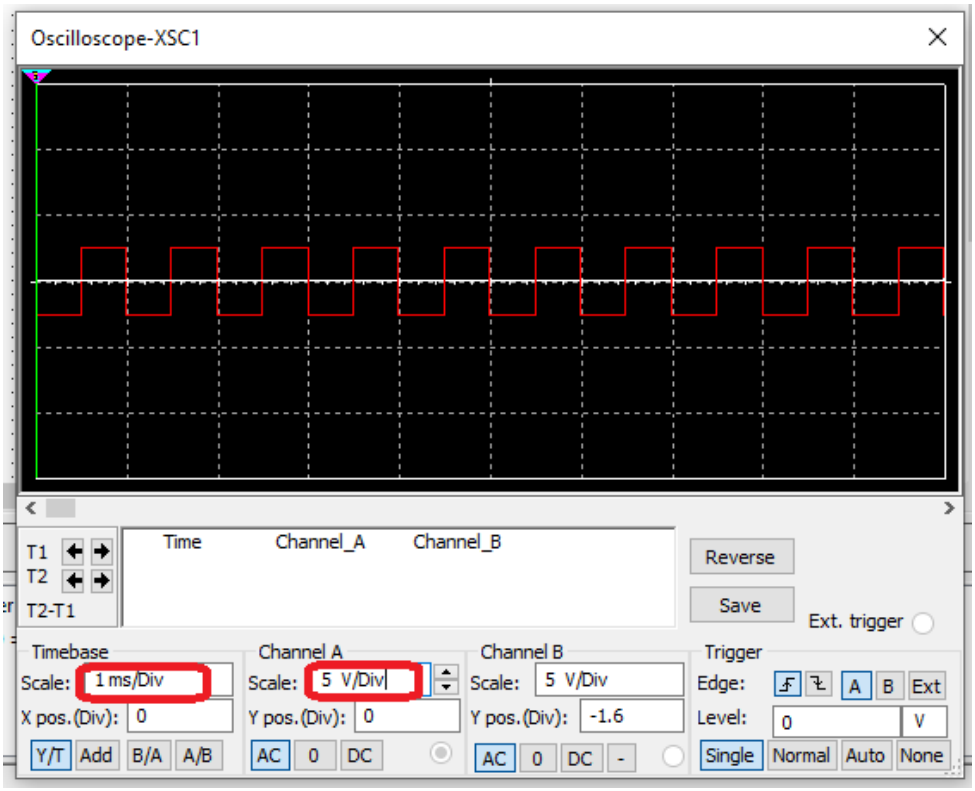
Connect ‘+’ and ‘COM’ Terminal of Function Generator (XPG1) to Channel A of Oscilloscope (XSC1).



b. Now set the value of Function Generator by double clicking on it, Set the following value then closethis window



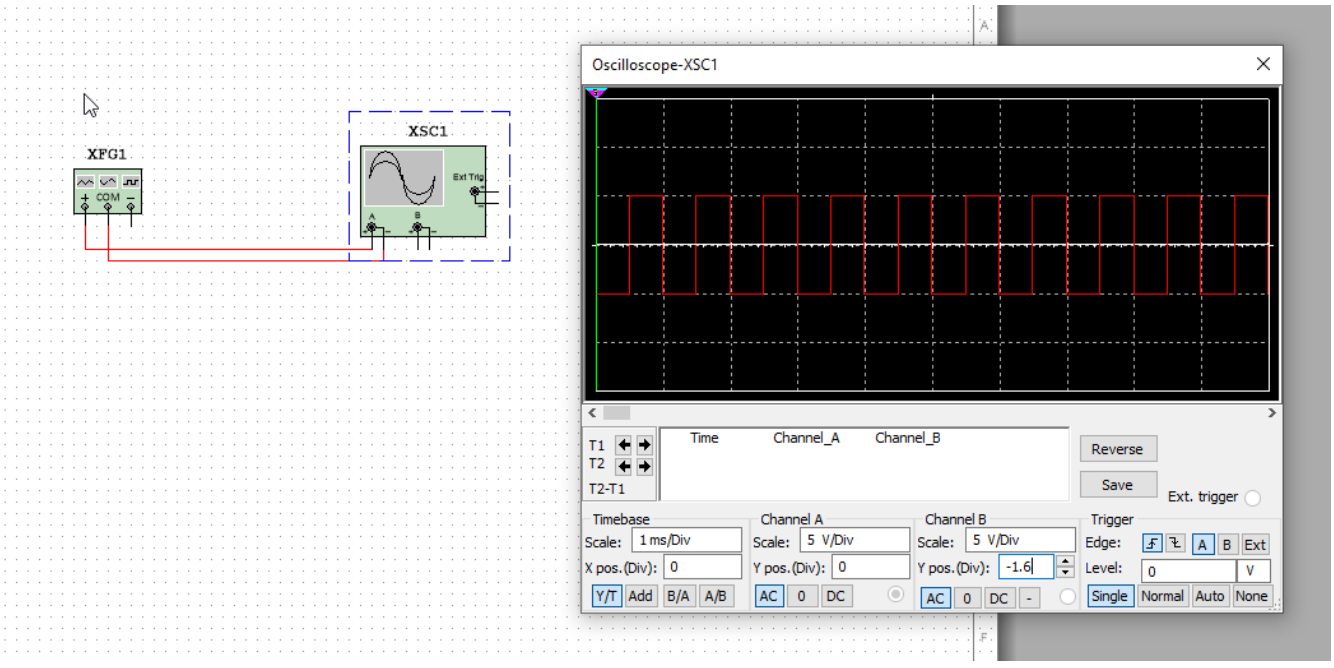
c. Run the circuit by clicking on Play Button or by F5. Now double click on Oscilloscope to see thegenerated square wave. Keep following settings



Q: Generate a square wave of 5 V, 1KHz from Function Generator to CRO. Calculate its time period and Draw thewaveform? Draw another wave form with 2KHz frequency.

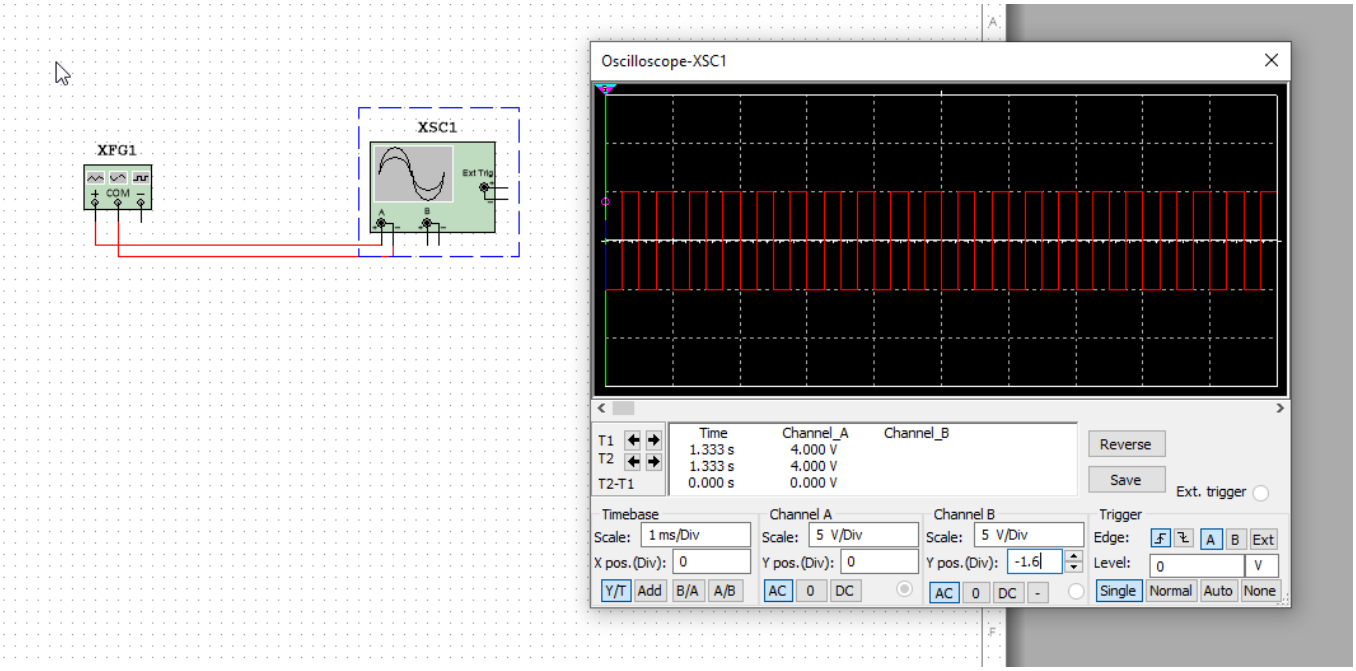
A: 5V, 1KHz wave

Time Period = 1/Frequency = 1/1KHz = 0.001 seconds = 1 ms



5V, 2KHz wave

Time Period =1/Frequency = 1/2KHz = 0.0005 seconds = 0.5 ms



Run 3:

Understanding the IC data sheet of NOT Gate

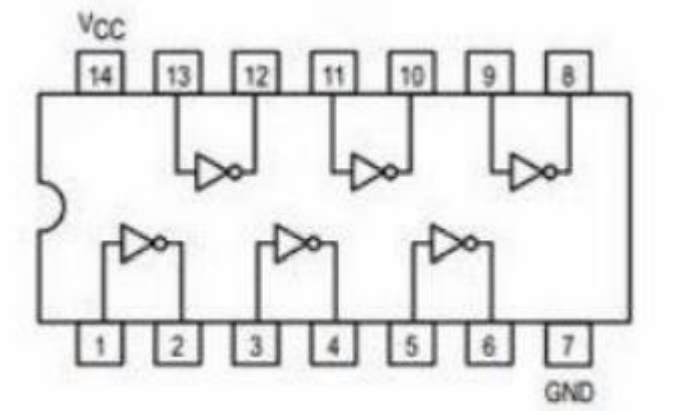
Refer Appendix-I for IC Data Sheet

(a) Pin Diagram
(b) Voltage nominal +/- tolerance
(c) Logic low range
(d) Logic high range
(e) Gate delay

Q: Write is the IC no. of NOT Gate? Draw its Pin Diagram?

A: IC 7404

Pin Diagram:



Q: How much voltage is required to operate an IC and write the voltage tolerance?

A: A supply voltage of 5V is required to operate an IC. The supply can range from 4.75V(min) to 5.25(max) value.

Q: Why we connect VCC and Ground?

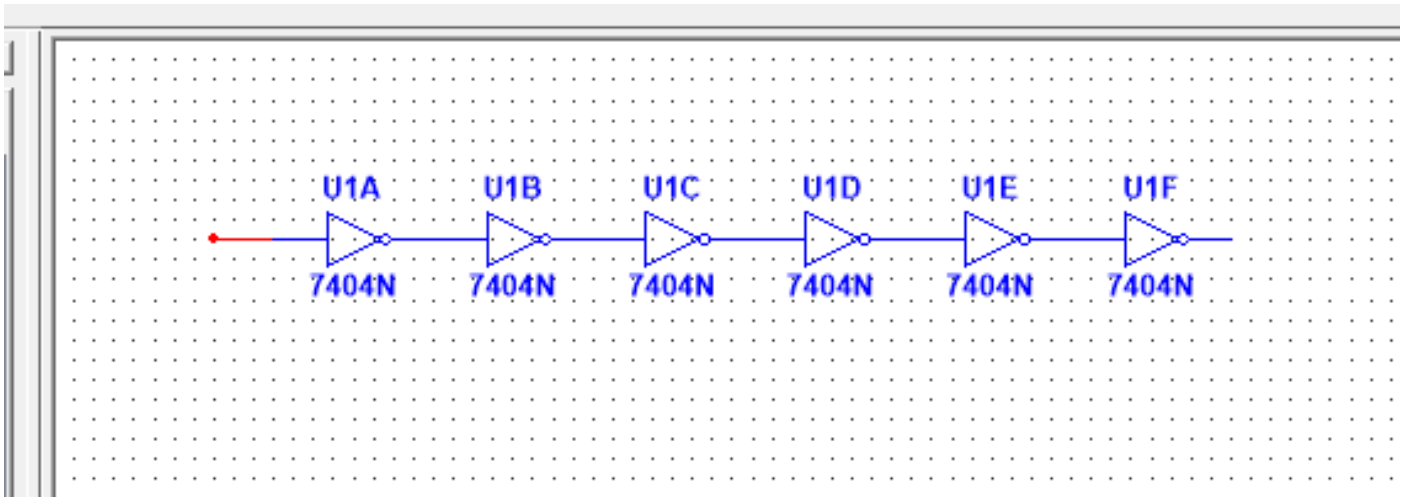
A: VCC (Voltage Common Collector) is the power supply of a device. Ground is the reference point against which the VCC is compared. It can be positive or negative compared to GND. The negative terminal of the battery is connected to the ground. Grounding provides a safe “path of least resistance” for stray voltage to follow.

Q: This IC is belonging to which family and What is the Logical low and high range of it?

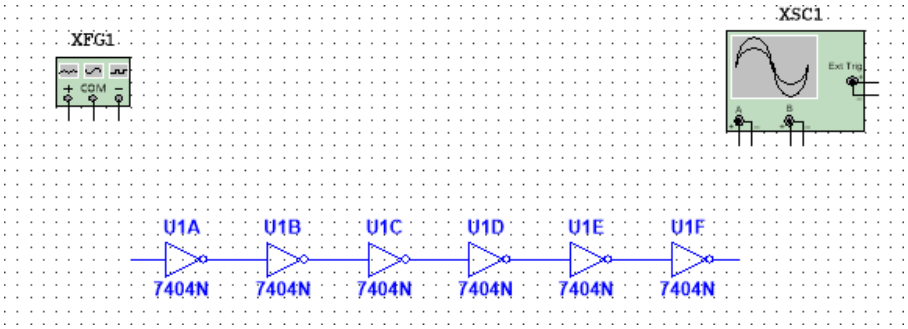
A: The IC 7404 belongs to the 7400 series. A voltage greater than 2V will be considered as HIGH (1) and voltage less than 0.8V will be considered as LOW (0).

Run 4: Propagation delay of gates using NOT Gate

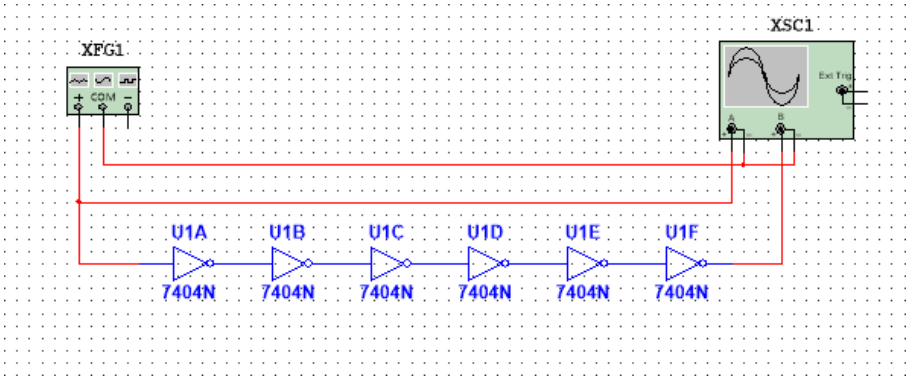
a. Connect the six not gates of IC 7404 in cascade as shown below. Use all 6 Gates from same IC.



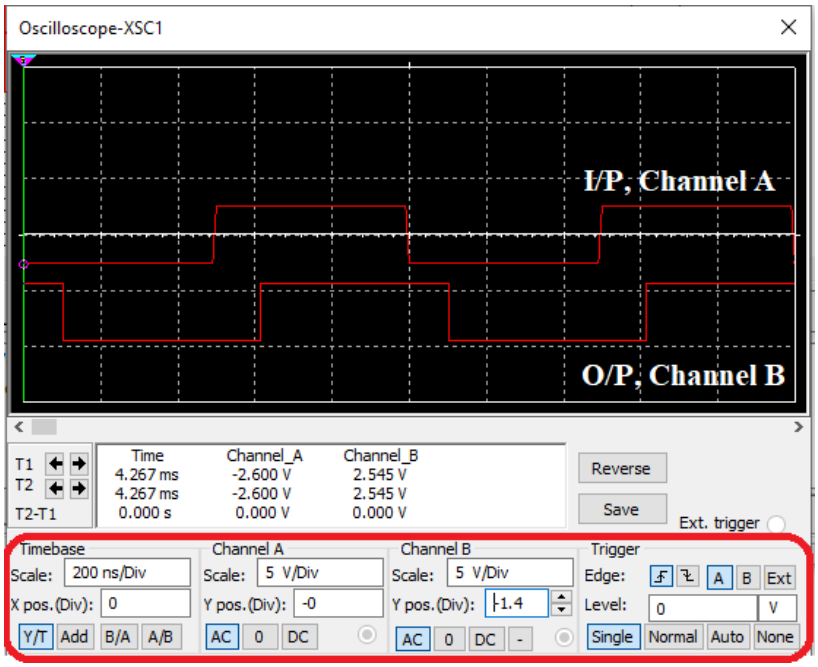
b. Add Function Generator and Oscilloscope from Right side panel of Multisim.



c. Connect Function Generator to I/P of first NOT gate and Channel A of Oscilloscope. Similarly connectO/P of sixth NOT gate to Channel B of Oscilloscope.

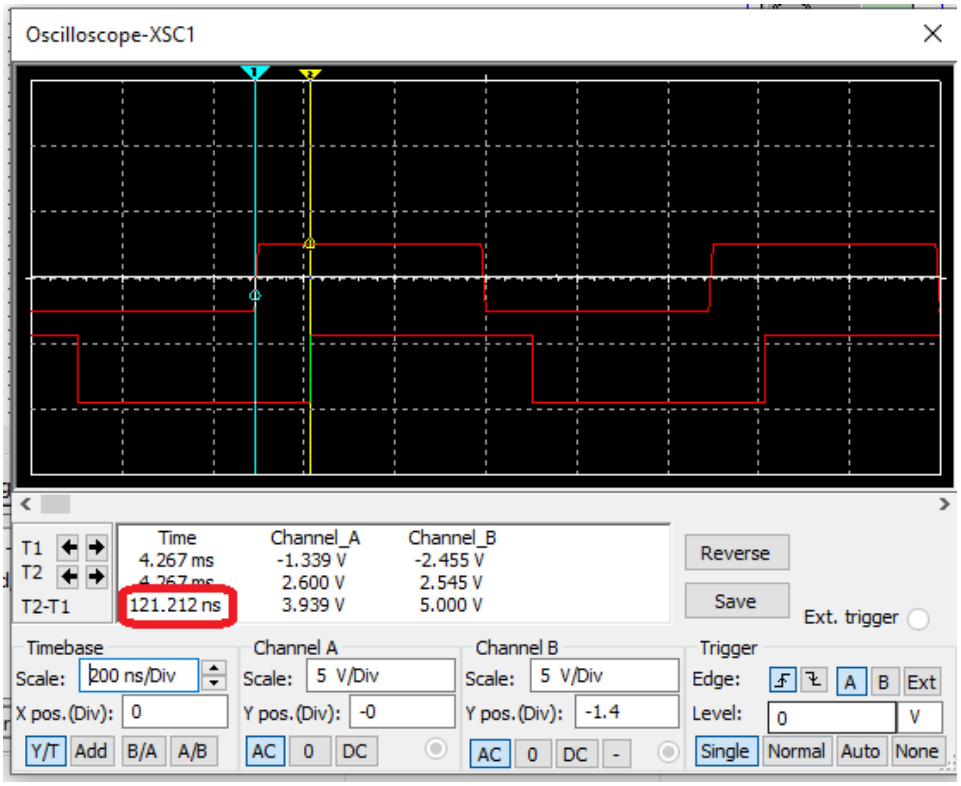


d. Generate a Square wave of 2.6 V and 1 MHz from Function Generator. Run the circuit and observethe Oscilloscope waveform with following settings.



e. Here you can observe that O/P is having some delay with I/P. this delay is called Propagation Delay.

f. Place the Marker on both signal and note down the delay (T2-T1). This delay is called tPLH. This istPLH of 6 NOT gates similarly, note down the tPHL.

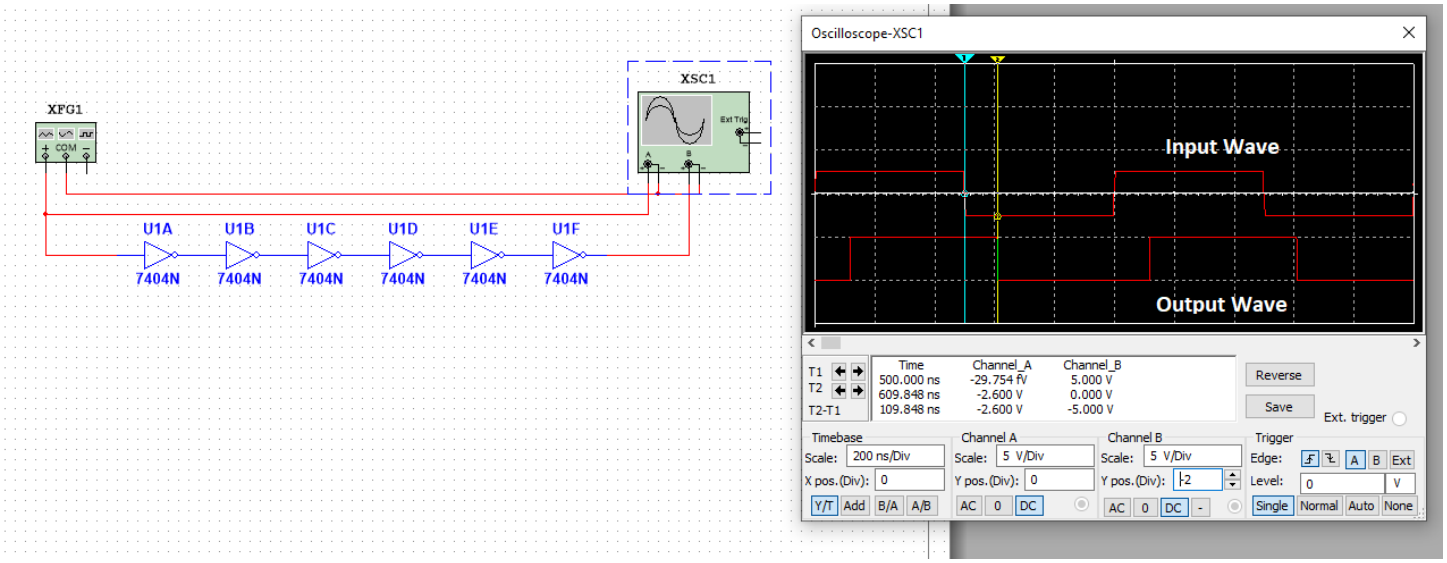


Q: Define Propagation delay time?

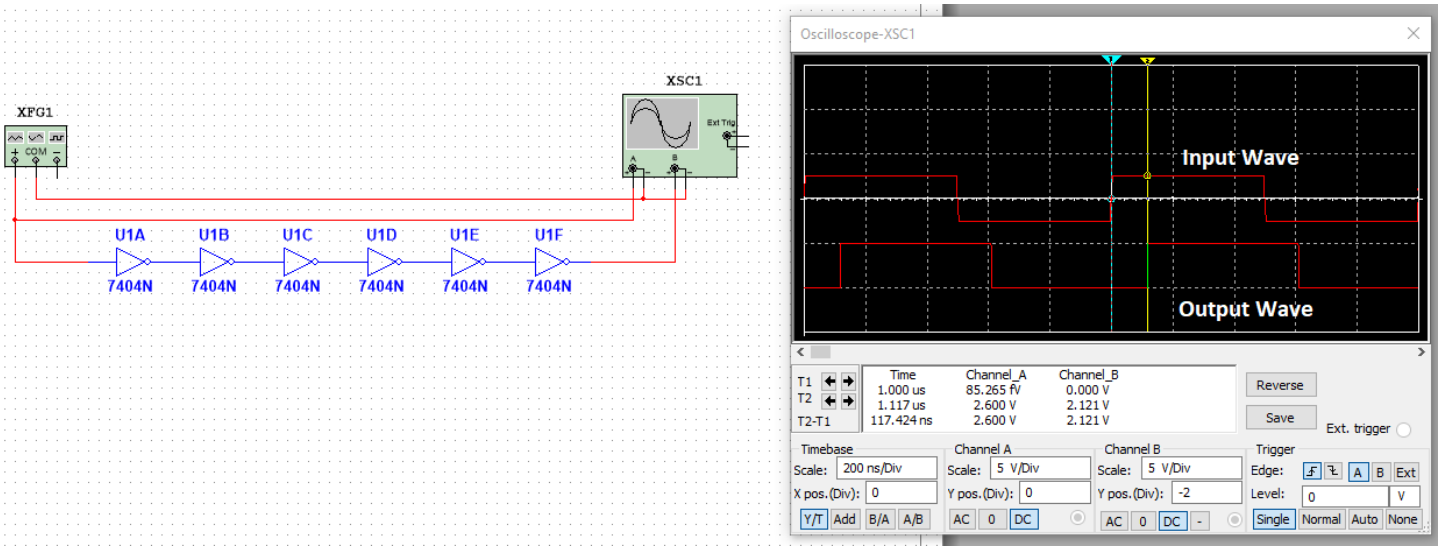
A: The time required for a change in the input to a logic gate or logic circuit to produce a change in the output. It is usually very brief. It is inherent in any gate or circuit, being caused by unavoidable delays in transistor switching and propagation of electric signals through passive components.

Q: Draw the I/P and O/P wave form.

A: tPHL : 109.848 ns



tPLH: 117.424 ns



Q: Note down the tPHL and tPLH and calculate the propagation delay of each gate?

A: Input clock frequency: 1MHz

tPHL: 109.848 ns

tPLH: 117.424 ns

Average propagation delay(P.D) = (tPHL + tPLH) / 2 = 113.636 ns

Delay per gate = P.D/6 = 18.93933 ns