Experiment-1	Discrete Devices	Diode Characteristics

Aim: To determine and plot the V-I characteristics of a 1N4148 Silicon Diode

1. Connect the 1K Ω and 1N4148 along with the voltage input and outputs following the circuit diagram onto the breadboard as indicated in the test setup.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Analog Panel and reset the Index.
3. Using the GUI Feed the test voltages -5V to -2.0V in 1.0V steps -2.0V to +2V in 0.2V steps and +2V to +9V in 1.0V steps. Use -Vout1 and Test Setup (Fig 3) for negative voltages and +Vout1 (Fig 2) for positive voltages. Save each set of values.
4. Plot the data using the Plot XY (VI) mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

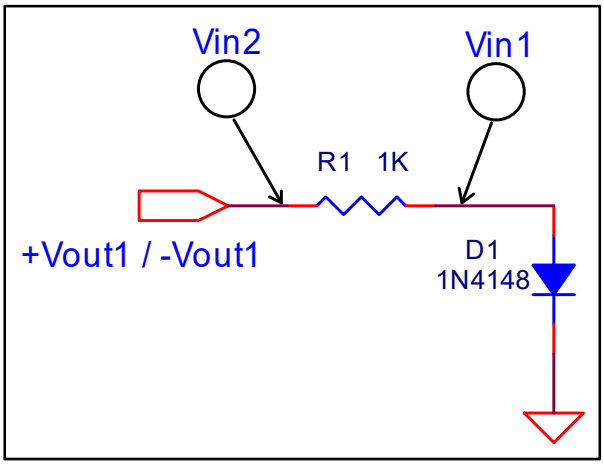

Fig 1. Circuit Diagram

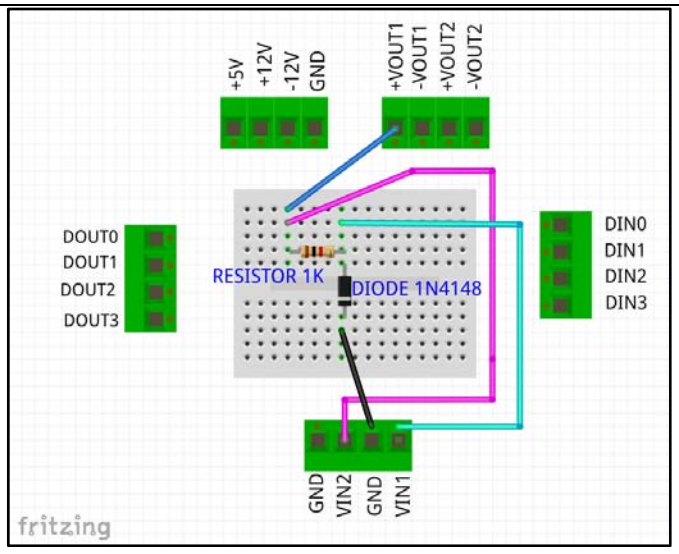

Fig 2. Test Setup (Forward)

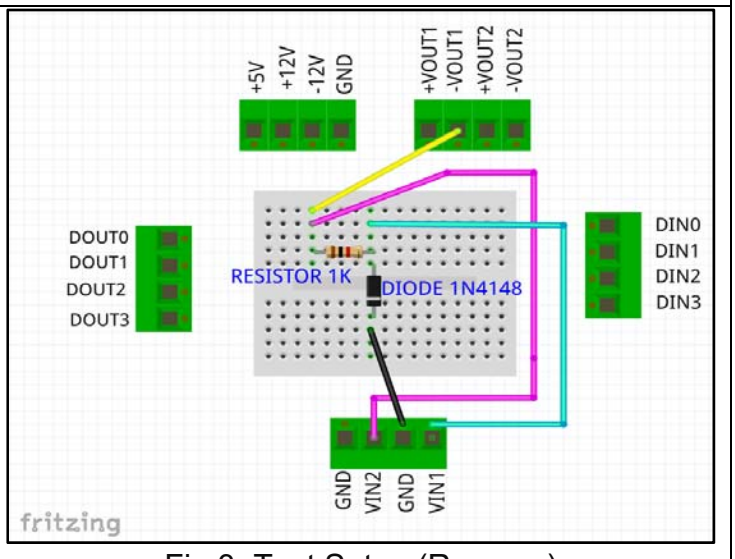

Fig 3. Test Setup (Reverse)

Test Results

When the forward voltage V_D crosses a knee voltage of approximately 0.7 V there is a sharp increase in the diode current I_D. The reverse characteristics show a very small current.

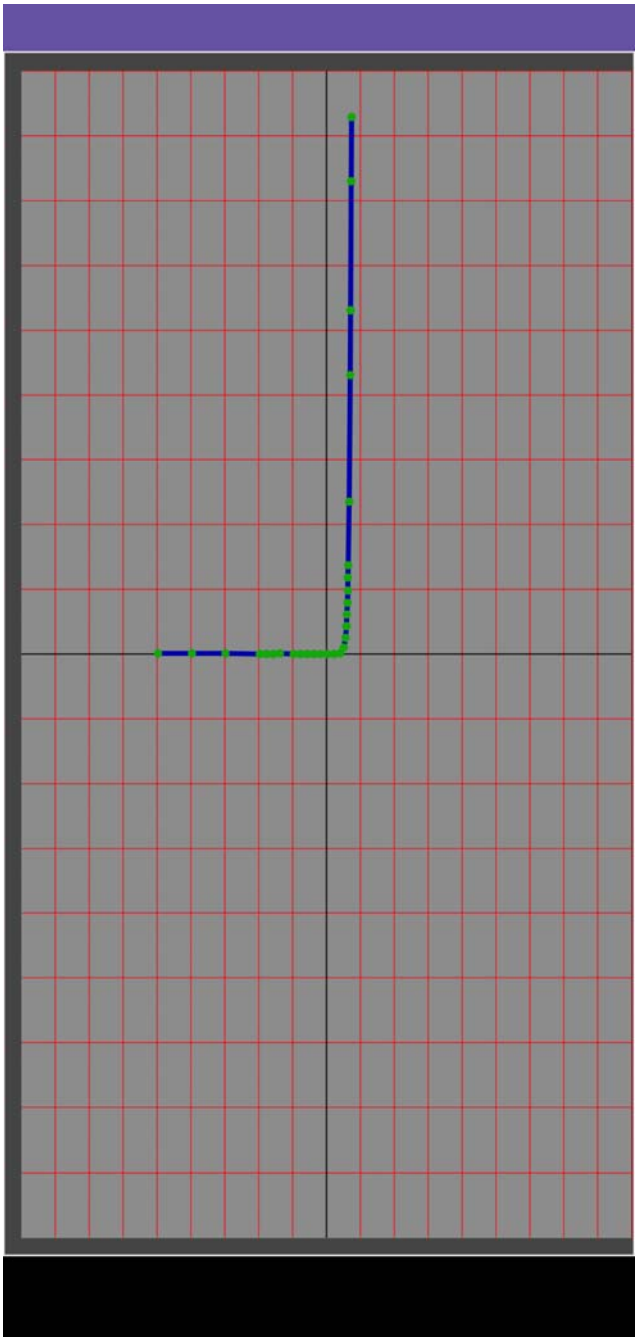

Fig 4. Test Results
Diode Characteristics
Diode Voltage vs. Diode Current
(x-axis, 1V/division, y-axis, 1mA/division)

Experiment-2	Discrete Devices	Zener Diode Characteristics

Aim: To determine and plot the V-I characteristics of a 1N4278 Zener Diode

1. Connect the 1K Ω and 1N4148 along with the voltage input and outputs following the circuit diagram onto the breadboard as indicated in the test setup.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Analog Panel and reset the Index.
3. Using the GUI Feed the test voltages -9V to -0.0V in 0.5V steps, 0V to +2V in 0.2V steps and +2V to +9V in 1.0V steps. Use -Vout1 and Test Setup (Fig 7) for negative voltages and +Vout1 (Fig 6) for positive voltages. Save each set of values.
4. Plot the data using the Plot XY (VI) mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

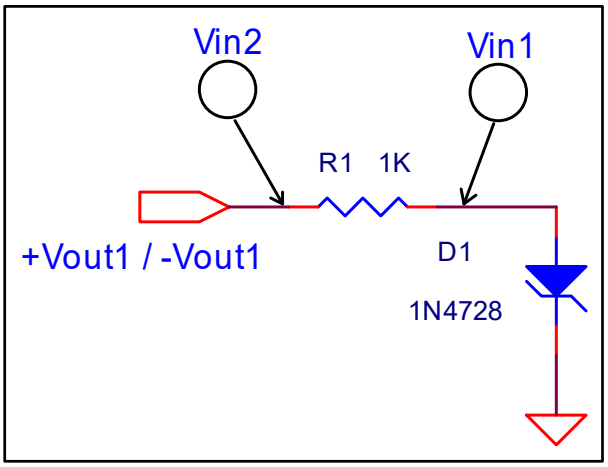

Fig 5. Circuit Diagram

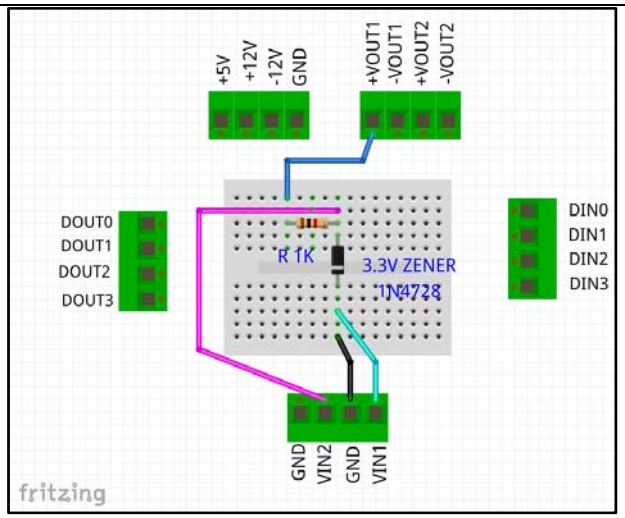

Fig 6. Test Setup (Positive Values)

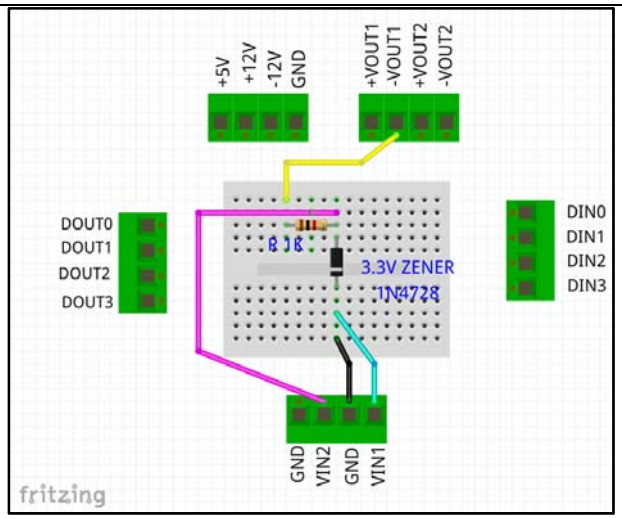

Fig 7. Test Setup (Negative Values)

Test Results

The forward characteristics are similar to a Silicon Diode and the reverse characteristics show a Zener breakdown voltage of ~3.0V.

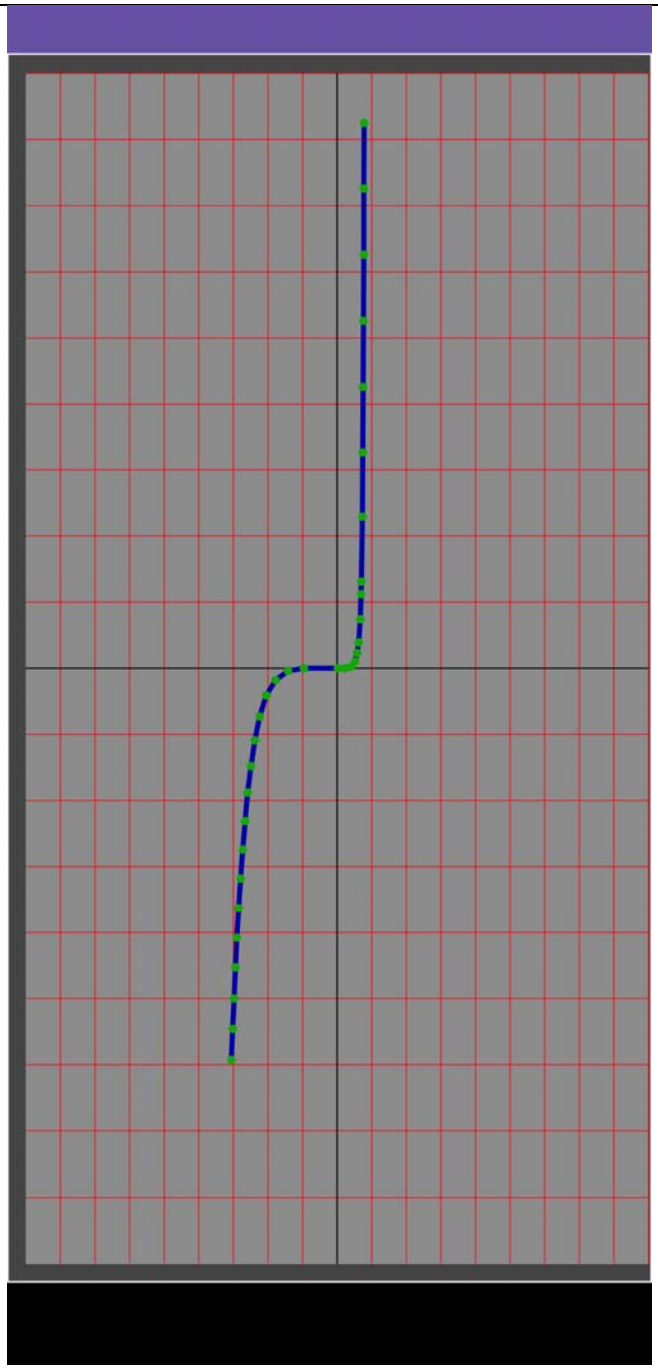

Fig 8 Test Results
Zener Diode Characteristics
Zener Diode Voltage vs. Diode Current
(x-axis, 1V/division, y-axis, 1mA/division)

Experiment-3	Discrete Devices	Half Wave Rectifier

Aim: To determine and plot the characteristics of a Half-Wave Rectifier using a 1N4148 diode.

1. Connect the 1N4148 and 1K Ω along with the voltage input and outputs following the circuit diagram onto the breadboard as indicated in the test setup.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Analog Panel and reset the Index.
3. Using the GUI Feed the simulated Sin-Wave test voltages: 0.0, 2.32, 4.5, 6.36, 7.79, 8.69, 9.0, 8.69, 7.79, 6.36, 4.5, 2.32, 0.00, -2.32, -4.5, -6.36, -7.79, -8.69, -9.0, -8.69, -7.79, -6.36, -4.5, -2.32, and 0.00. Use Vout1 and Test Setup (Fig 10) for positive voltages and -Vout1 (Fig 11) for negative voltages. Save each set of values.
4. Plot the data using the Plot IO (VoVin) mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

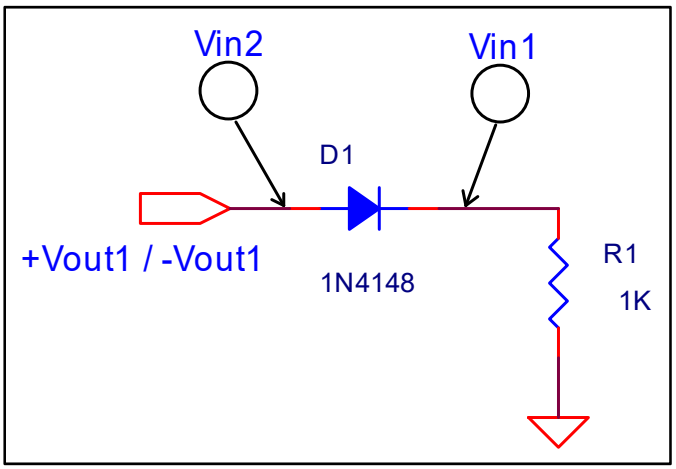

Fig 9. Circuit Diagram

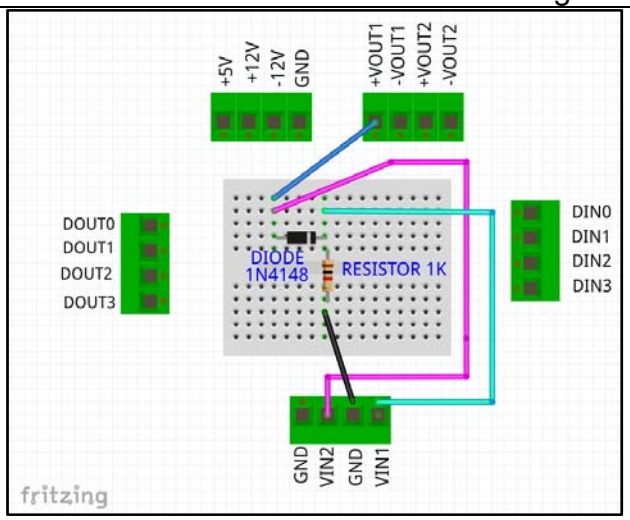

Fig 10. Test Setup (Positive Values)

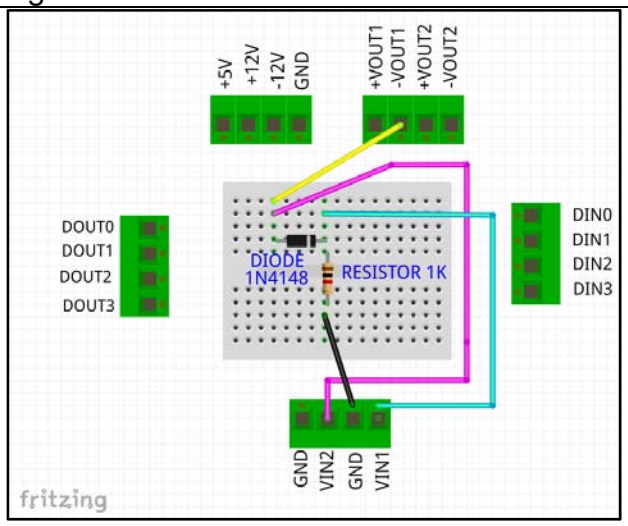

Fig 11. Test Setup (Negative Values)

Test Results

Only the positive half-cycle is available across the load resistor, with a ~0.7V drop corresponding to the forward voltage of a silicon diode. The negative-half cycle is blocked.

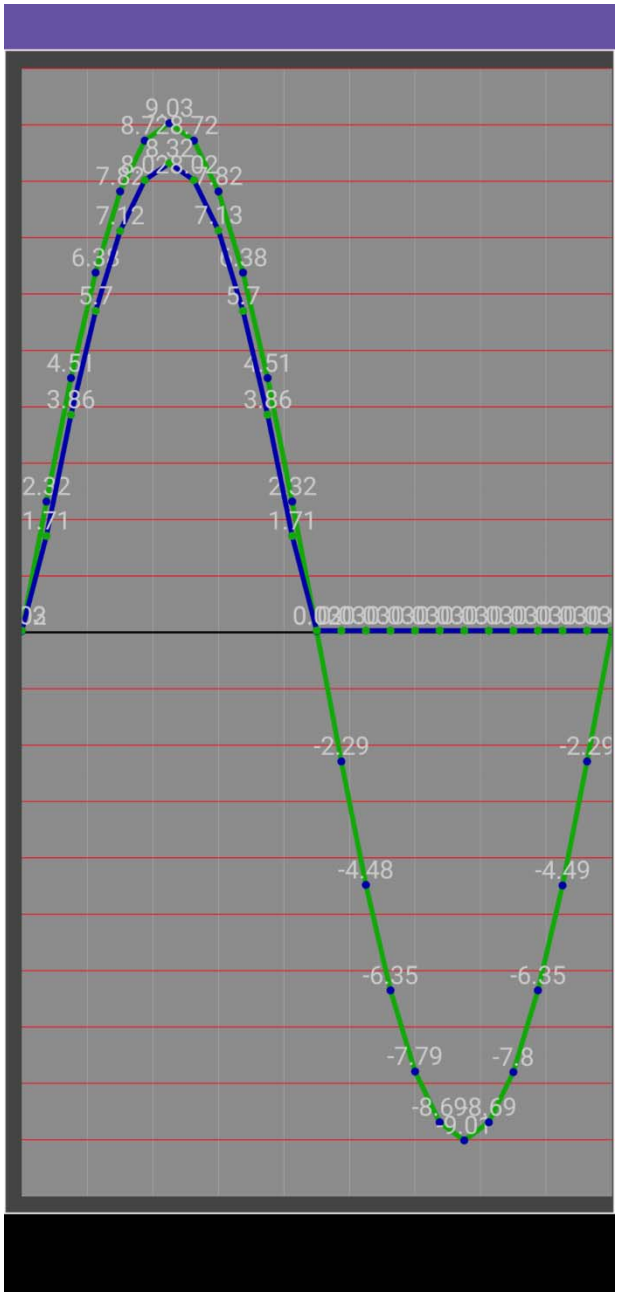

Fig 12. Test Results
Half Wave Rectifier Input/output Characteristics
Input (green) and Output (blue) vs. Sample Number
(x-axis, 1V/division, y-axis, Samples)

Experiment-4	Discrete Devices	Full Wave Rectifier

Aim: To determine and plot the characteristics of a Full-Wave Rectifier using 1N4148 diodes.

1. Connect the 4 X 1N4148 and 1K Ω along with the voltage input and outputs following the circuit diagram onto the breadboard as indicated in the test setup.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Analog Panel and reset the Index.
3. Using the GUI Feed the simulated Sin-Wave test voltages: 0.0, 2.32, 4.5, 6.36, 7.79, 8.69, 9.0, 8.69, 7.79, 6.36, 4.5, 2.32, 0.00, -2.32, -4.5, -6.36, -7.79, -8.69, -9.0, -8.69, -7.79, -6.36, -4.5, -2.32, and 0.00. Use Vout1 and Test Setup (Fig 14) for positive voltages and -Vout1 (Fig 15) for negative voltages. Save each set of values.
4. Plot the data using the Plot IO (VI) mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

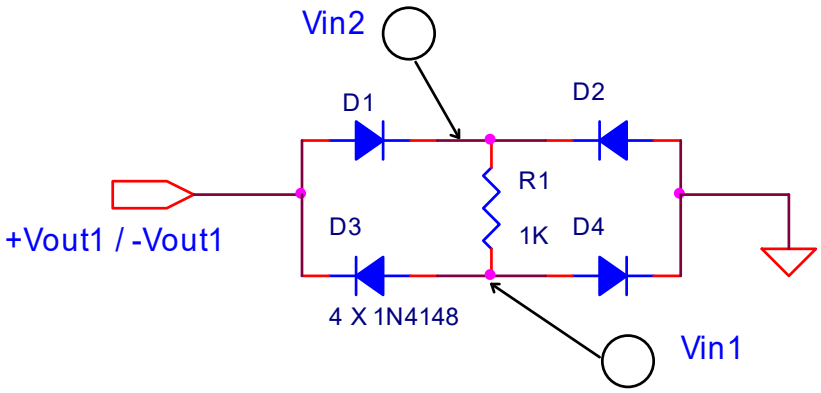

Fig 13. Circuit Diagram

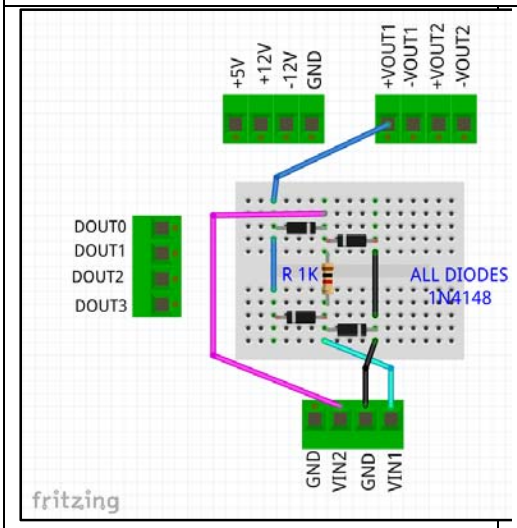

Fig 14. Test Setup (Positive Values)

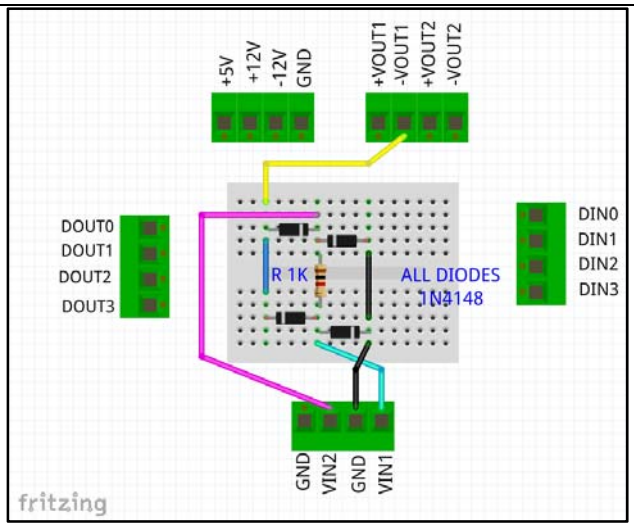

Fig 15. Test Setup (Negative Values)

Test Results

Both the positive and negative half-cycles appear as positive half-cycles across the load resistor, with an ~1.4V drop corresponding to the forward voltage of two silicon diode in series.

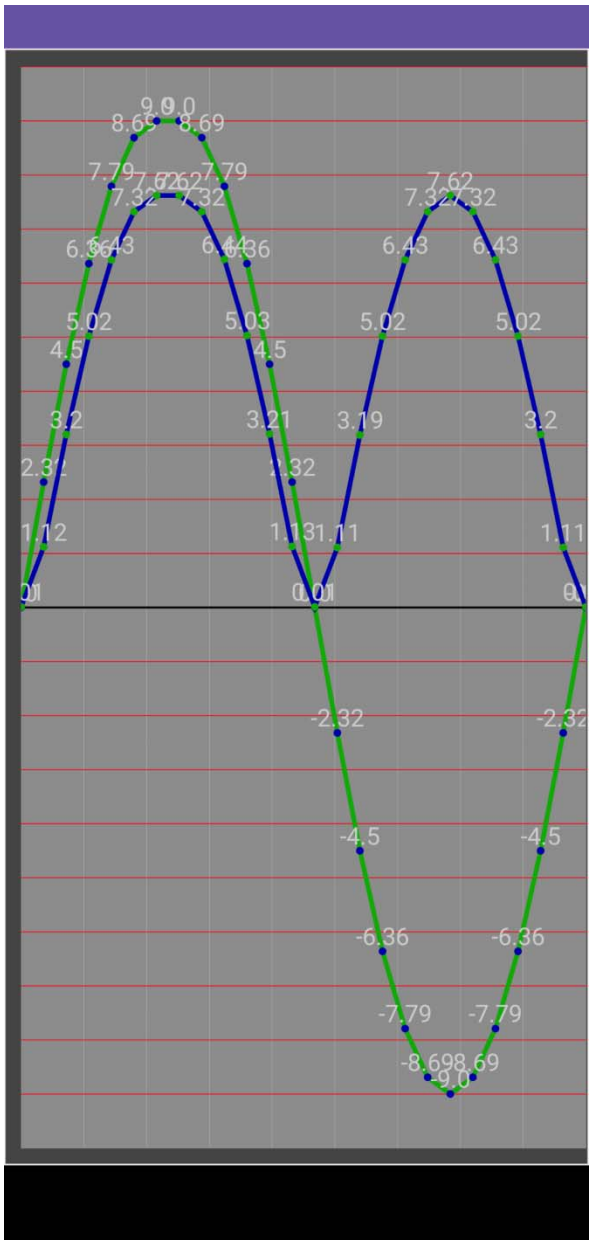

Fig 16. Test Results
Full Wave Rectifier Input/output Characteristics
Input (green) and Output (blue) vs. Sample Number
(x-axis, 1V/division, y-axis, Samples)

Experiment-5	Digital Circuits	Inverter

Aim: To determine and plot the input/output characteristics of a Digital Inverter using IC LM7404.

1. Connect the Hex Inverter LM7404 along with +5V supply and ground using the setup shown in Fig 18.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Digital Panel and reset the Index.
3. Using the GUI set DOUT0 with L and H values alternately and observe the logic output at DIN3.
4. Plot the data using the Plot Digital mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

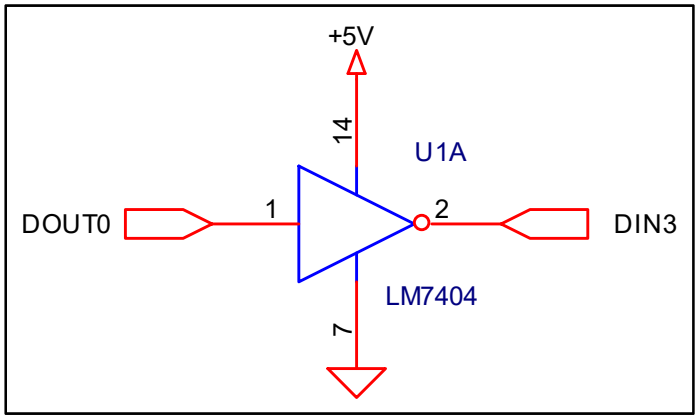

Fig 17. Circuit Diagram

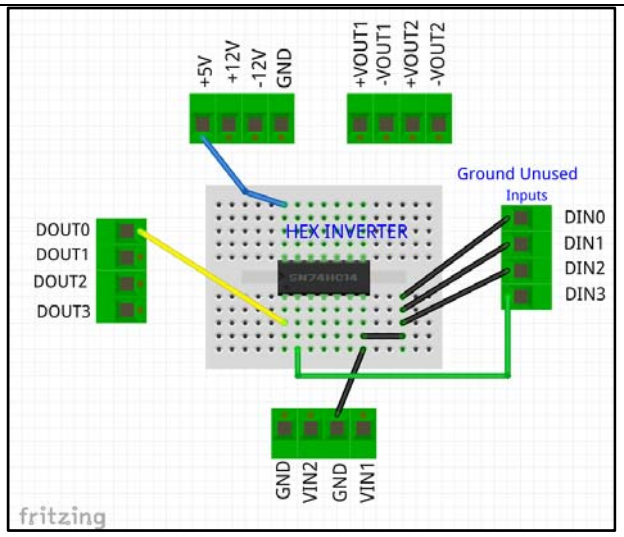

Fig 18. Test Setup

Inverter

Input	Output
DOUT0	DIN3
L	H
H	L

Fig 19. Truth Table

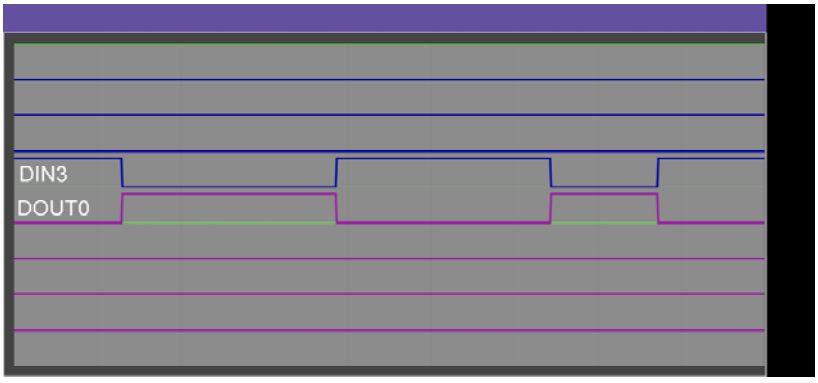

Fig 20. Input Output Plot

Experiment-6	Digital Circuits	2-Input NAND Gate

Aim: To determine and plot the input/output characteristics of a 2-Input NAND Gate using IC LM7400.

1. Connect the Quad NAND gate IC LM7400 along with +5V supply and ground using the setup shown in Fig 22.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Digital Panel and reset the Index.
3. Using the GUI set DOUT0 and DOUT1 with L and H values as per the truth table in Fig 23 and observe the logic output at DIN3.
4. Plot the data using the Plot Digital mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

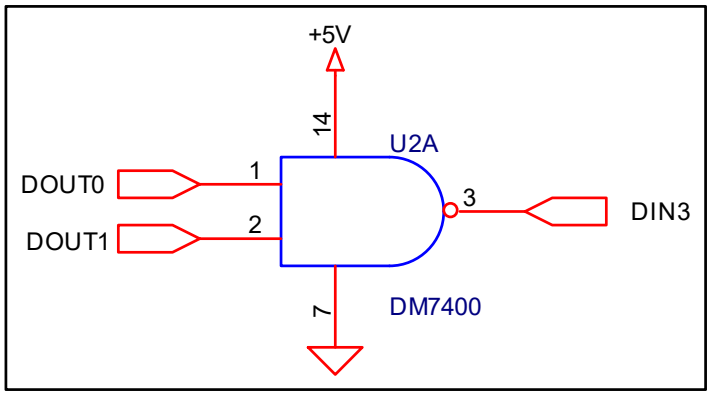

Fig 21. Circuit Diagram

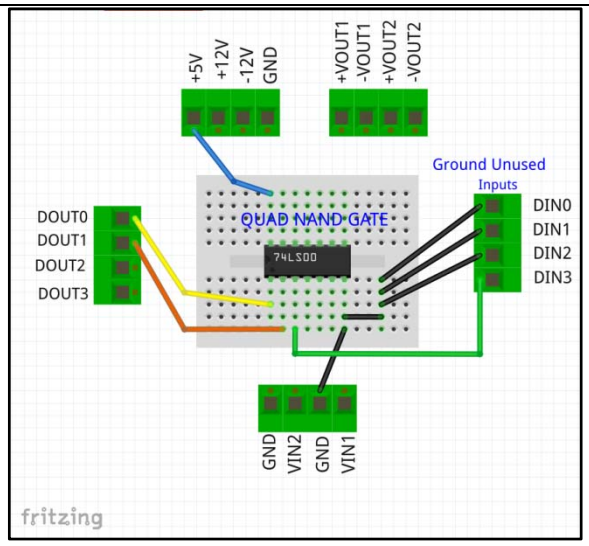

Fig 22. Test Setup

NAND Gate

Input 1	Input 2	Output
DOUT0	DOUT1	DIN3
L	L	H
H	L	H
H	H	L
L	H	H

Fig 23. Truth Table

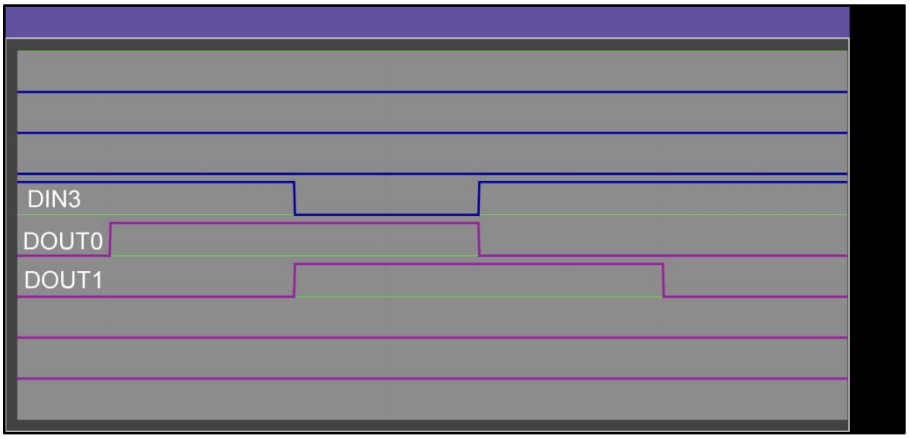

Fig 24. Input Output Plot

Experiment-7	Digital Circuits	Decade Counter

Aim: To determine and plot the reset/count characteristics of a Decade Counter using IC LM7490.

1. Connect the Decade Counter using IC LM7490 along with +5V supply and ground using the setup shown in Fig 26.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Digital Panel and reset the Index.
3. Using the GUI set DOUT0, DOUT1 and DOUT2 with L and H values as per the truth table in Fig 27 and observe the logic output at DIN0, DIN1, DIN2 and DIN3.
4. Plot the data using the Plot Digital mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

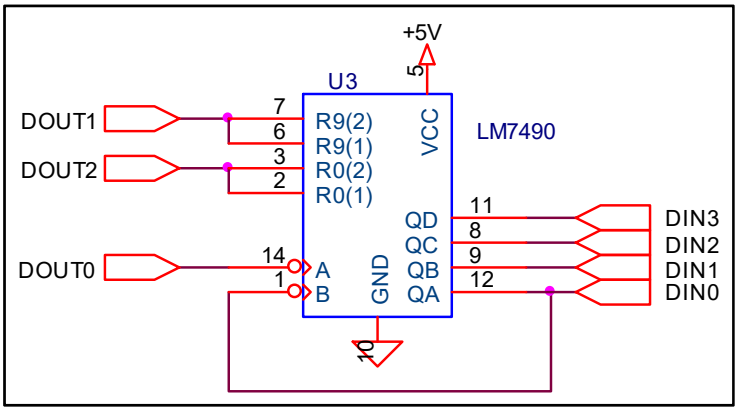

Fig 25. Circuit Diagram

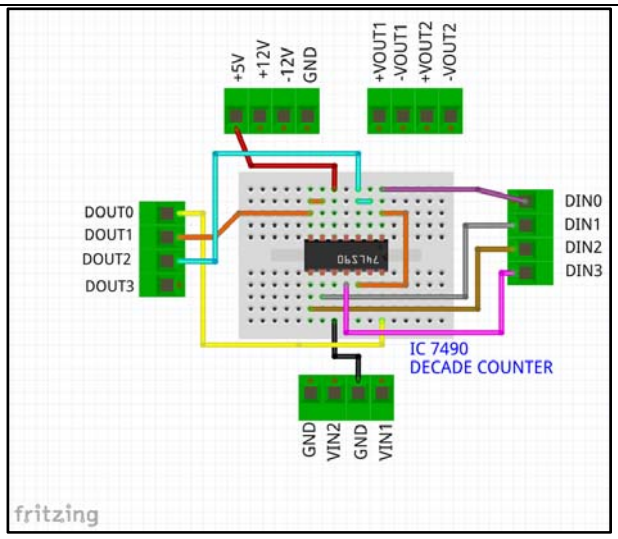

Fig 26. Test Setup

Decade Counter

Count	Outputs			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

Reset/Count Function Table

Reset Inputs				Outputs			
R0(1)	R0(2)	R9(1)	R9(2)	Q_D	Q_C	Q_B	Q_A
H	H	L	X	L	L	L	L
H	H	X	L	L	L	L	L
X	X	H	H	H	L	L	H
X	L	X	L	COUNT			
L	X	L	X	COUNT			
L	X	X	L	COUNT			
X	L	L	X	COUNT			

Fig 27. Truth Table

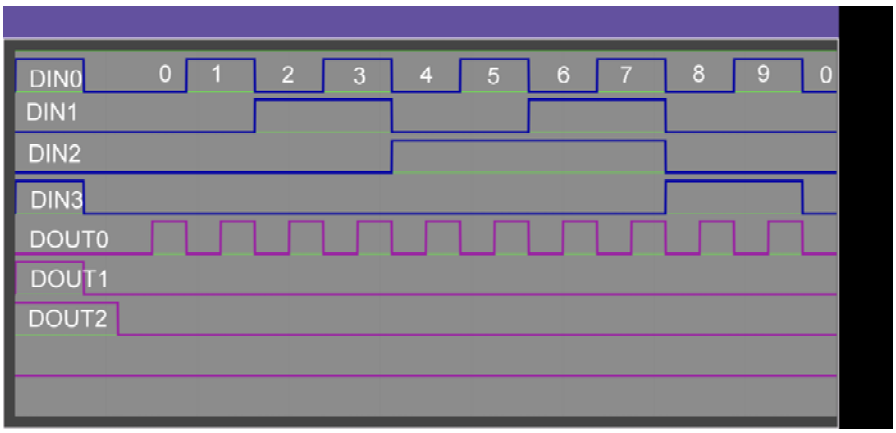

Fig 28. Reset and Count Sequence

Experiment-8	Analog Circuits	OpAmp Inverting Amplifier

Aim: To determine and plot the gain characteristics of an Operational Amplifier in Inverting Configuration using IC LM741.

1. Connect the Operational Amplifier using IC LM741 along with +12V/-12V supply and ground using the setup shown in Fig 30.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Analog Panel and reset the Index.
3. Using the GUI set VOUT1 and VOUT2 as per the table in Fig 31 and observe the voltage output at Vin2 = - (Vout1 * R2/R1 + Vout2 * R2/R3) .
4. Plot the data using the Plot IO (VoVin) mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

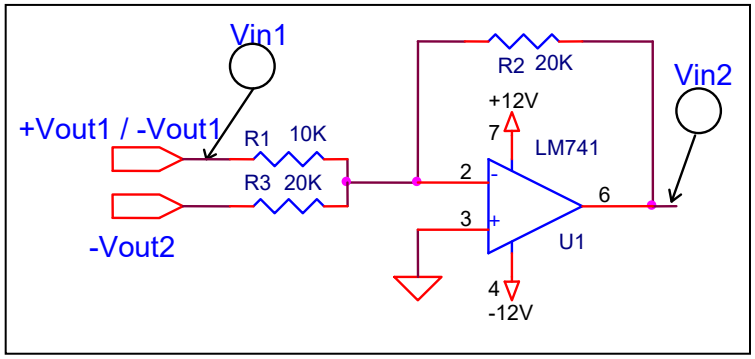

Fig 29. Circuit Diagram

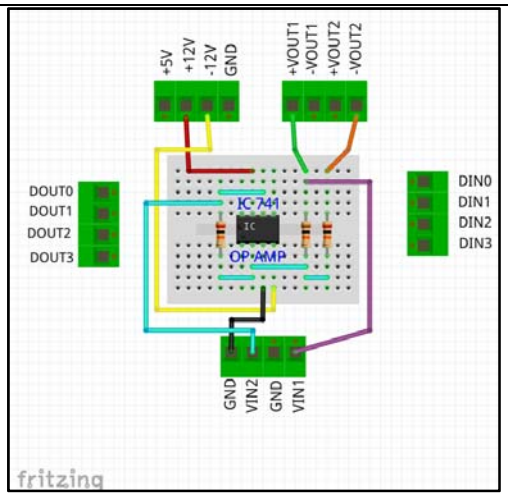

Fig 30. Test Setup

Inverting Summing Amplifier

Vout1	Vout2	Vin1	Vin2
0	0	0.01	0.01
1	0	1	-1.96
2	0	2	-3.95
3	0	3.01	-5.96
4	0	4.01	-7.95
4	-1	3.99	-6.94
4	-2	3.99	-5.93
4	-3	3.99	-4.91
4	-4	3.99	-3.93
4	-5	4.0	-2.93

Vin2 = - (Vout1 * 2 + Vout2 * 1)

Fig 31. Test Value Table

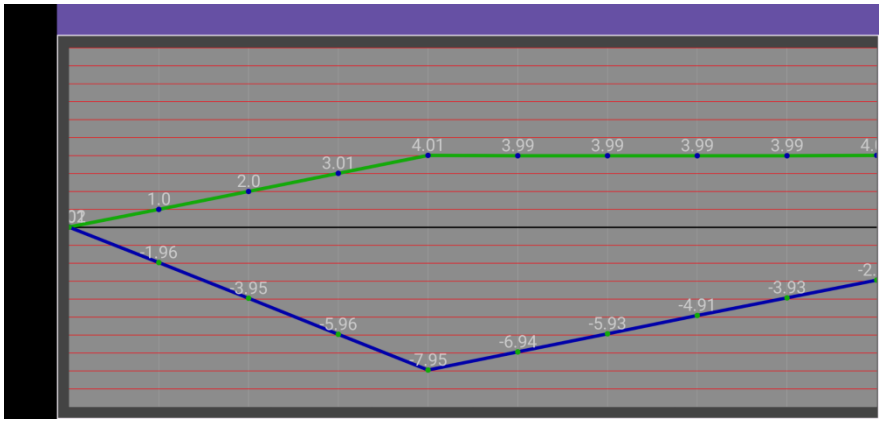

Fig 32. Plot of Vin1 and Vin2 vs. Samples

Experiment-9	Analog Circuits	OpAmp Non-Inverting Amplifier

Aim: To determine and plot the gain characteristics of an Operational Amplifier in Non-Inverting Configuration using IC LM741.

1. Connect the Operational Amplifier using IC LM741 along with +12V/-12V supply and ground using the setup shown in Fig 34.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Analog Panel and reset the Index.
3. Using the GUI set VOUT1 as per the table in Fig 35 and observe the voltage output at Vin2 = (Vout1 * 1+R2/R1).
4. Plot the data using the Plot IO (VoVin) mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

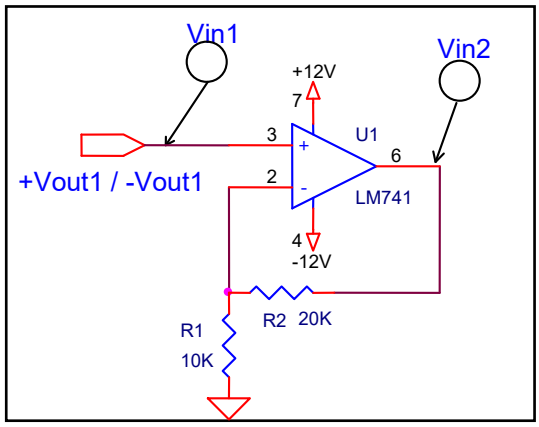

Fig 33. Circuit Diagram

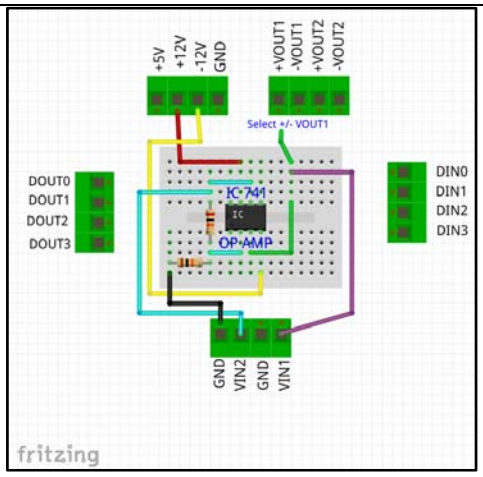

Fig 34. Test Setup

Non- Inverting Amplifier

Vout1	Vin1	Vin2	Vout1	Vin1	Vin2
0.0	0.01	0.02	-0.0	0.01	0.01
0.5	0.5	1.47	-0.5	-0.47	-1.44
1.0	1.0	2.97	-1.0	-0.97	-2.94
1.5	1.5	4.46	-1.5	-1.47	-4.44
2.0	2.0	5.96	-2.0	-1.97	-5.93
2.5	2.5	7.44	-2.5	-2.47	-7.42
3.0	3.01	8.97	-3.0	-2.98	-8.95

Vin2 = (Vout1 *3)

Fig 35. Test Value Table

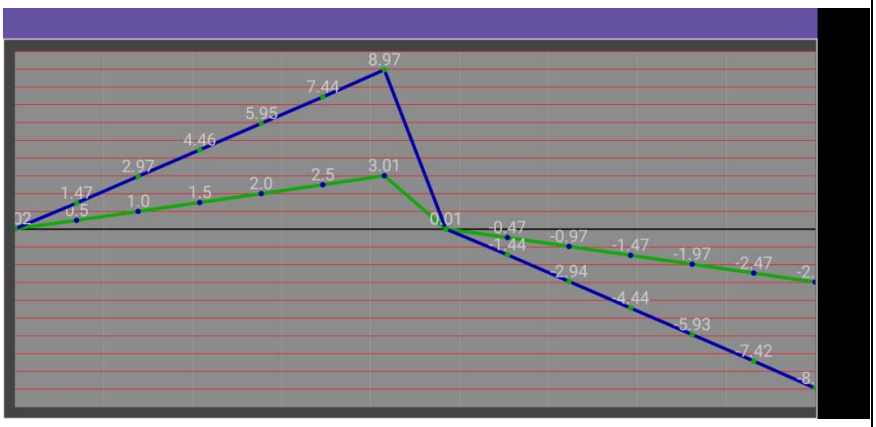

Fig 36. Plot of Vin1 and Vin2 vs. Samples

Experiment-10	Analog Circuits	Comparator

Aim: To determine and plot the Input / Output characteristics of a Voltage Comparator using IC LM311.

1. Connect Voltage Comparator using IC LM311along with +5V supply and ground using the setup shown in Fig 38.
2. Power up the test set and connect using Bluetooth using the mobile application. Change to Analog Panel and reset the Index.
3. Using the GUI set VOUT2 to +2.5V and VOUT1, 0V to 5V and back to 0V in 0.5V steps.
4. Plot the linear data using the Plot IO (VoVin) mode and Hysteresis Plot using the Plot XY(VoVin) mode.
5. Observe the plotted results and save the screen using 'Screen Shot' for further annotation and reporting.

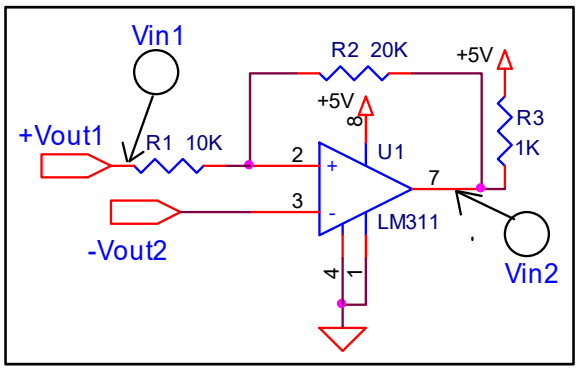

Fig 37. Circuit Diagram

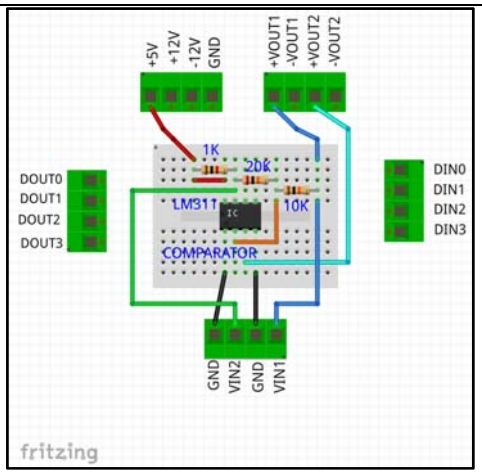

Fig 38. Test Setup

Voltage Comparator

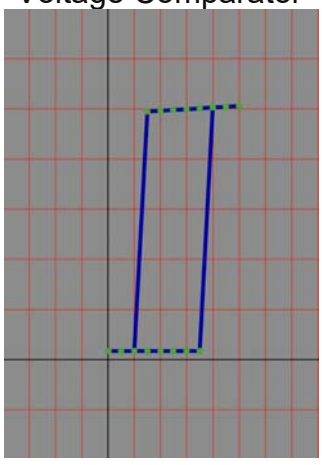

Fig 39. Hysteresis Plot

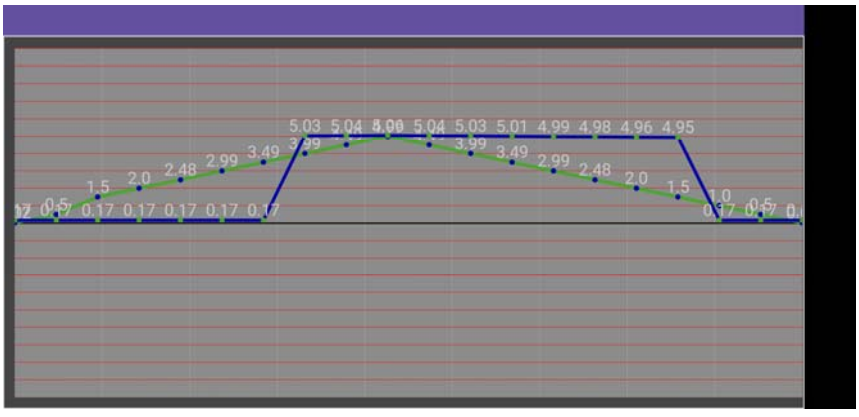

Fig 40. Plot of Vin1 and Vin2 vs. Samples