GOVT CO-ED POLYTECHNIC

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LAB MANUAL

Branch : Electrical Engineering

Year & Semester : 2nd Year / 3rd Semester

2025361(024) – Electrical Circuits (Lab)

CONTENTS

EXPERIMENT - 1

(A) VERIFICATION OF KVL AND KCL

1.1 AIM:

To verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) in a Passive Resistive Network .

1.2 APPARATUS:

S. No	Apparatus Name	Range	Type	Quantity
1	RPS			
2	Ammeter			
3	Voltmeter			
4	Resistors			
5	Bread Board	-	-	01
6	Connecting Wires	-	-	As required

1.3 CIRCUIT DIAGRAMS:

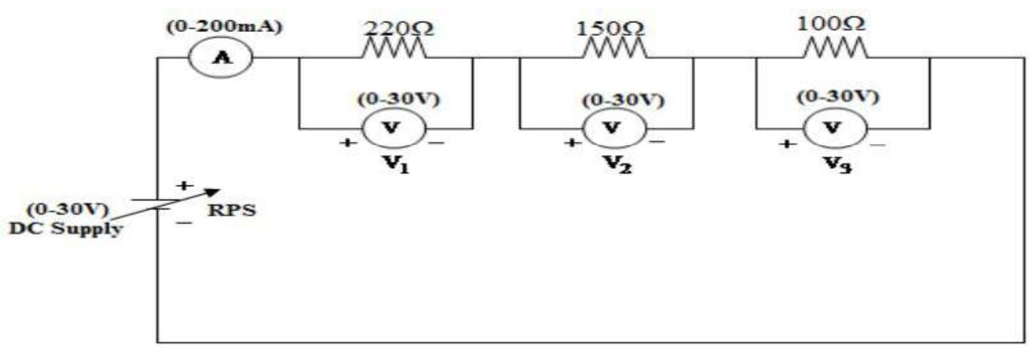

Figure – 1.1 Verification of KVL

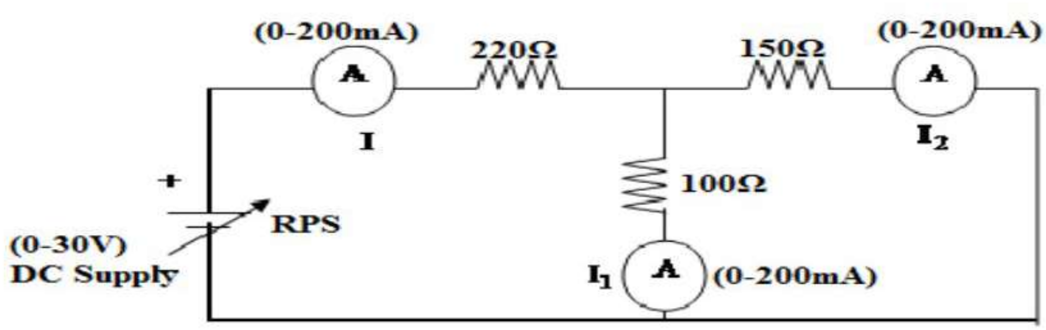

Figure – 1.2 Verification of KCL

1.4 PROCEDURE:

To Verify KVL

1. Connect the circuit diagram as shown in Figure 1.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5v) and note the voltmeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of voltmeters.
6. sum up the voltmeter readings (voltage drops) , that should be equal to applied voltage .
7. Thus KVL is Verified practically.

To Verify KCL

1. Connect the circuit diagram as shown in Figure 2.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5v) and note the Ammeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of Ammeters.
6. Sum up the Ammeter readings (I_1 and I_2) , that should be equal to total current (I).
7. Thus KCL is Verified practically

1.5 OBSERVATIONS:

For KVL

Applied Voltage V (volts)	V_1 (volts)		V_2 (volts)		V_3 (volts)		$V_1+V_2+V_3$ (volts)	
	Theoritical	Practical	Theoritical	Practical	Theoritical	Practical	Theoritical	Practical

For KCL

Applied Voltage V (volts)	I (A)		I_1 (A)		I_2 (A)		I_1+I_2 (A)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

1.6 PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected.

1.7 RESULT:

(B)VERIFICATION OF KVL AND KCL USING DIGITAL SIMULATION.

1.8 AIM:

To verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) using digital simulation.

1.9 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

1.10 CIRCUIT DIAGRAMS:

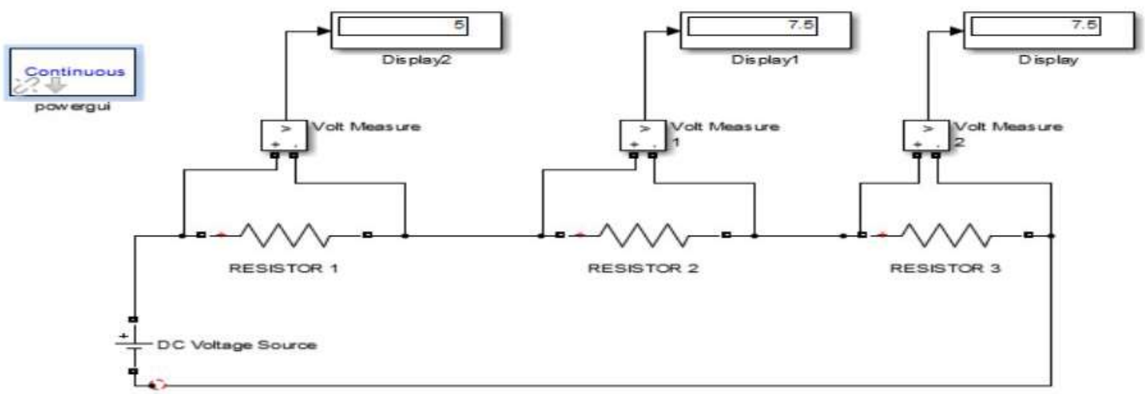

Figure – 1.3 Verification of KVL

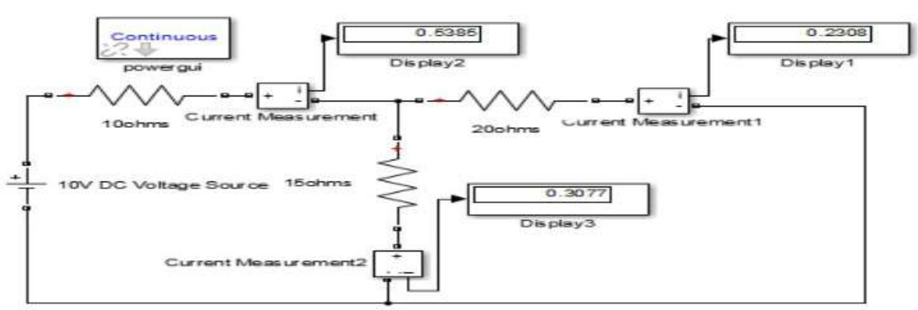

Figure – 1.4 Verification of KCL

1.11 PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure the voltages and currents in each resistor.
3. Verify the KVL and KCL.

1.12 OBSERVATIONS:

For KVL

Applied Voltage V (volts)	V_1 (volts)		V_2 (volts)		V_3 (volts)		$V_1+V_2+V_3$ (volts)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

For KCL

Applied Voltage V (volts)	I (A)		I_1 (A)		I_2 (A)		I_1+I_2 (A)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

1.13 RESULT:

1.14 PRE LAB VIVA QUESTIONS:

1. Define current.
2. Define voltage.
3. What is resistance?
4. Define ohm's law.
5. State KCL and KVL.

1.15 POST LAB VIVA QUESTIONS:

1. What do you mean by junction?
2. Derive current division rule.
3. Explain the sign conventions.
4. Explain the color coding of resistors.

EXPERIMENT - 2

(A) MESH ANALYSIS

2.1 AIM

The study of mesh analysis is the objective of this exercise, specifically its usage in multi-source DC circuits. Its application in finding circuit currents and voltages will be investigated.

2.2 APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Resistors			
2.	Ammeter			
3.	R.P.S			
4.	Bread Board			
5.	Connecting Wires			required

2.3 THEORY:

Multi-source DC circuits may be analyzed using a mesh current technique. The process involves identifying a minimum number of small loops such that every component exists in at least one loop. KVL is then applied to each loop. The loop currents are referred to as mesh currents as each current interlocks or meshes with the surrounding loop currents. As a result there will be a set of simultaneous equations created, an unknown mesh current for each loop. Once the mesh currents are determined, various branch currents and component voltages may be derived.

2.4 CIRCUIT DIAGRAM:

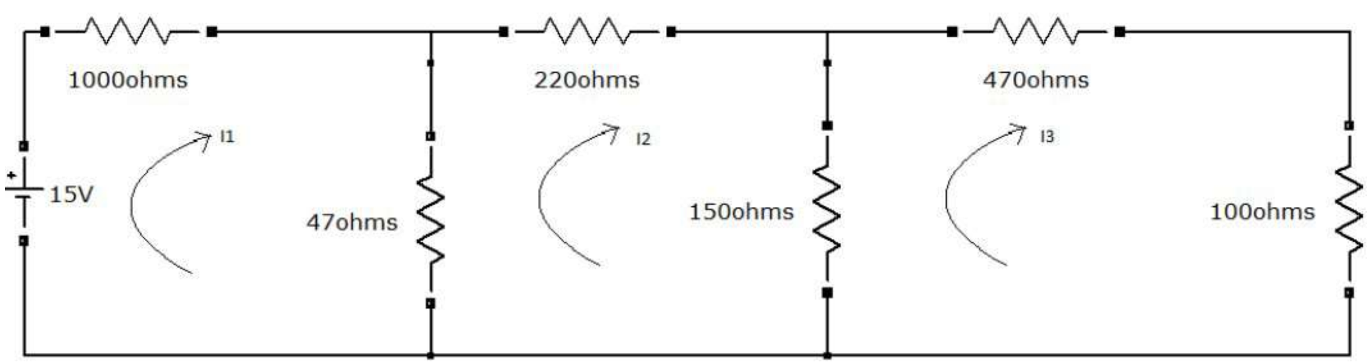

Figure – 2.1 Mesh analyses

2.5 PROCEDURE

1. Connect the circuit diagram as shown in Figure 2.1.
2. Switch ON the supply to RPS.

3. Apply the voltage (say 15v).
4. Gradually increase the supply voltage in steps.
5. Connect ammeters in the loop and find the currents I_1, I_2 and I_3.
6. Verify the practical results obtained with theoretical results

2.6 OBSERVATIONS:

Applied Voltage V (volts)	Loop current(I_1)		Loop current (I_2)		Loop current(I_3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

2.7 PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected.

2.8 RESULT:

(B) MESH ANALYSIS USING DIGITAL SIMULATION

AIM:

To verify mesh analysis using digital simulation.

2.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	01

2.10 SIMULATION DIAGRAMS:

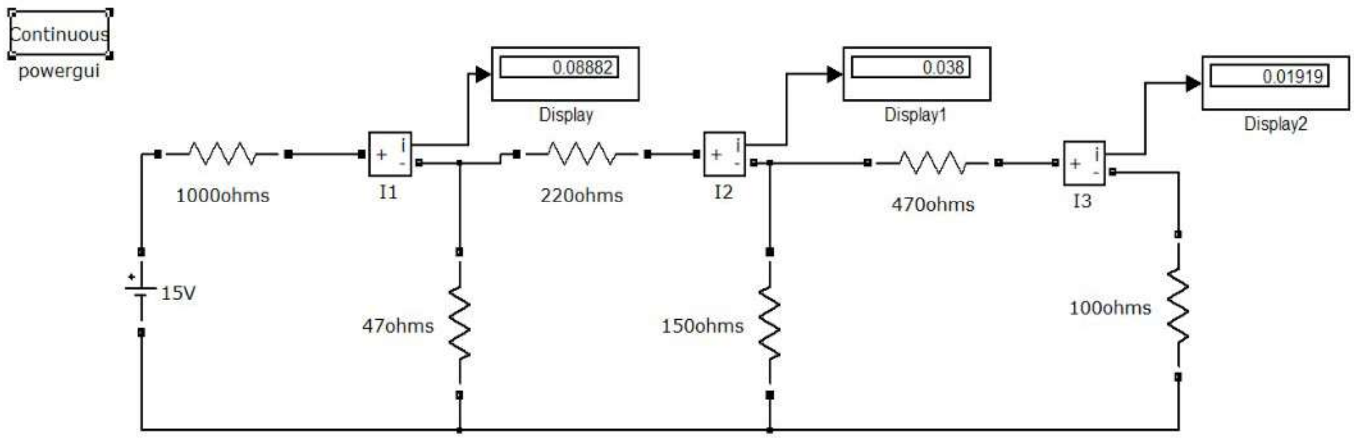

Figure – 2.2 Mesh analysis in MATLAB

2.11 PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure current in each resistor.
3. Verify the mesh analysis.

2.12 OBSERVATIONS:

Applied Voltage V (volts)	Loop current(I_1)		Loop current (I_2)		Loop current(I_3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

2.13 RESULT

2.14 PRE LAB VIVA QUESTIONS:

1. On which law is the mesh analysis based?
2. What is mesh analysis?
3. When do we go for super mesh analysis?
4. What is the equation for determining the number of independent loop equations in mesh current method?

2.15 POST LAB VIVA QUESTIONS:

1. How do we calculate branch currents from loop currents?
2. How do we calculate branch voltages from loop currents?

EXPERIMENT - 3

(A) NODAL ANALYSIS

3.1 AIM

The study of nodal analysis is the objective of this exercise, specifically its usage in multi-source DC circuits. Its application in finding circuit node voltages will be investigated.

3.2 APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Resistors			
2.	Voltmeter			
3.	R.P.S			
4.	Bread Board			
5.	Connecting Wires			required

3.3 THEORY:

In electric circuits analysis, nodal analysis, node-voltage analysis, or the branch current method is a method of determining the voltage (potential difference) between "nodes" (points where elements or branches connect) in an electrical circuit in terms of the branch currents.

3.4 CIRCUIT DIAGRAM:

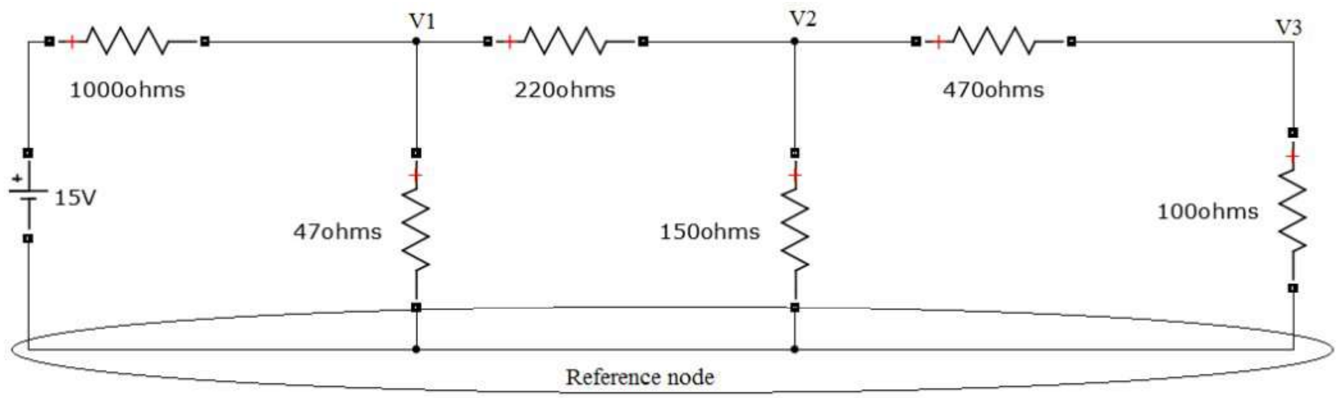

Figure – 3.1 Nodal analysis

3.5 PROCEDURE

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1. Connect the circuit diagram as shown in Figure 3.1.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 15v) and note the voltmeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of voltmeters.
6. Verify the practical results obtained with theoretical results.

3.6 OBSERVATIONS:

Applied Voltage V (volts)	Node voltage(v_1)		Node voltage(v_2)		Node voltage(v_3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

3.7 PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected.

3.8 RESULT

(B) NODAL ANALYSIS USING DIGITAL SIMULATION

3.9 AIM:

To verify nodal analysis using digital simulation.

3.10 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	01

3.11 SIMULATION DIAGRAMS:

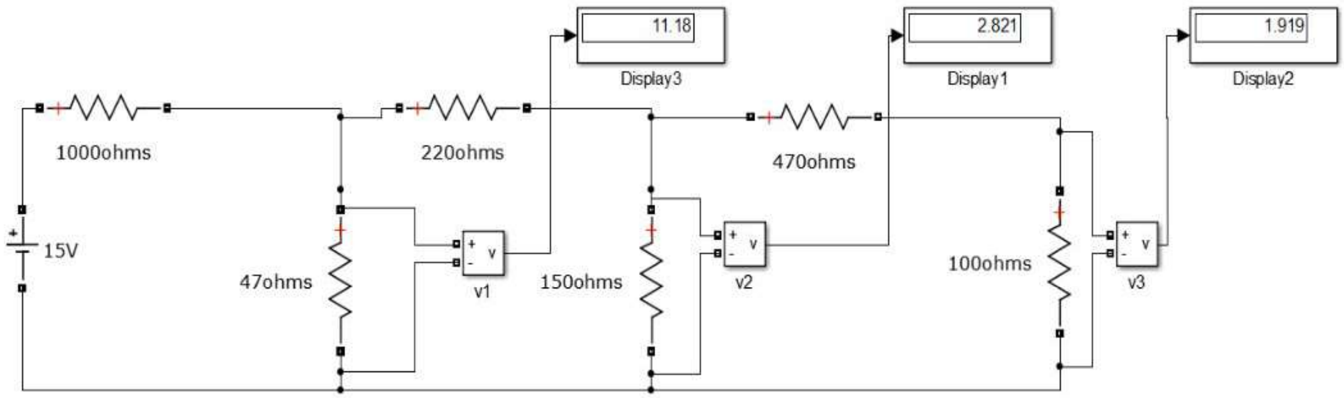

Figure – 3.2 Nodal analysis in MATLAB

3.12 PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure the voltage across each node using voltage measurement.
3. Verify with the theoretical results obtained with practical results

3.13 OBSERVATIONS:

Applied Voltage V (volts)	Node voltage(V_1)		Node voltage (V_2)		Node voltage (V_3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

3.14 RESULT:

3.15 PRE LAB VIVA QUESTIONS:

1. On which law is the nodal analysis based?
2. What is nodal analysis?
3. When do we, go for super-node analysis?

3.16 POST LAB VIVA QUESTIONS:

1. Define node.
2. Is nodal analysis is applicable to both dc and ac supply?
3. How do we calculate branch currents from node voltages?
4. How do we calculate branch voltages from node voltages?

EXPERIMENT - 4

AVERAGE VALUE, RMS VALUE, FORM FACTOR, PEAK FACTOR OF SINUSOIDAL WAVE, SQUARE WAVE

4.1 AIM:

To determine the average value, RMS value, form factor, peak factor of sinusoidal wave, square wave.

4.2 APPARATUS

S. No	Name	Range	Quantity
1	Resistors	100Ω	2 Nos
2	Inductor	1 mH	1 No
3	Function Generator		1 No
4	Multimeter		1 No
5	CRO		1 No

4.3 THEORY:

In alternating current (AC, also ac) the movement (or flow) of electric charge periodically reverses direction. An electric charge would for instance move forward, then backward, then forward, then backward, over and over again. In direct current (DC), the movement (or flow) of electric charge is only in one direction.

Average value: Average value of an alternating quantity is expressed as the ratio of area covered by wave form to distance of the wave form.

Root Mean Square (RMS) Value: The RMS value of an alternating current is expressed by that steady DC current which when flowing through a given circuit for given time produces same heat as produced by that AC through the sane circuit for the same time period. In the common case of alternating current when I(t) is a sinusoidal current, as is approximately true for mains power, the RMS value is easy to calculate from the continuous case equation above. If we define Ip to be the peak current, then in general form

$$I_{\mathrm{RMS}} = \sqrt{\frac{1}{T_2 - T_1} \int_{T_1}^{T_2} (I_{\mathrm{p}} \sin(\omega t)\,)^2 dt}.$$

Where t is time and ω is the angular frequency ($\omega = 2\pi/T$, where T is the period of the wave).
For a sinusoidal voltage,

$$V_{\mathrm{rms}} = \frac{V_{\mathrm{peak}}}{\sqrt{2}}.$$

The factor is called the crest factor, which varies for different waveforms. For a triangle wave form centered about zero.

$$V_{\rm rms} = \frac{V_{\rm peak}}{\sqrt{3}}.$$

For a square wave form centered about zero

RMS (Root Mean Square) value of an ac wave is the mean of the root of the square of the voltages at different instants. For an ac wave it will be 1/ √2 times the peak value.

4.4 CIRCUIT DIAGRAM:

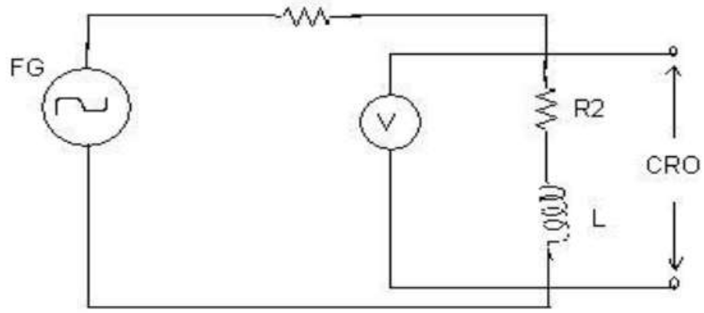

Fig – 4.1 Basic Circuit

4.5 PROCEDURE:

1. Connect the circuit as shown in the circuit diagram of fig. 4.1.
2. Set the value of frequency say 100 Hz in the function generator.
3. Adjust the ground of channel 1 and 2 of Cathode Ray Oscilloscope and then set it into DC mode.
4. Connect CRO across the load in DC mode and observe the waveform. Adjust the DC offset of function generator.
5. Note down the amplitude and frequency.
6. Set the multimeter into AC mode and measure input voltage and voltage across point AB. This value gives RMS value of sinusoidal AC.
7. Calculate the average value.
8. Repeat experiment for different frequency and different peak to peak voltage.
9. Measure the RMS and Average value of DC signal also where instead of function generator you can use DC supply.

4.5 OBSERVATIONS & CALCULATIONS:

Peak value (V)	RMS value (V)	Average value (V)

4.6 PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected

4.7 RESULT:

(B) AVERAGE VALUE, RMS VALUE, FORM FACTOR, PEAK FACTOR OF SINUSOIDAL WAVE, SQUARE WAVE USING DIGITAL SIMULATION

4.8 AIM:

To Determine the average value, RMS value, form factor, peak factor of sinusoidal wave, square wave.

4.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	01

4.10 CIRCUIT DIAGRAM:

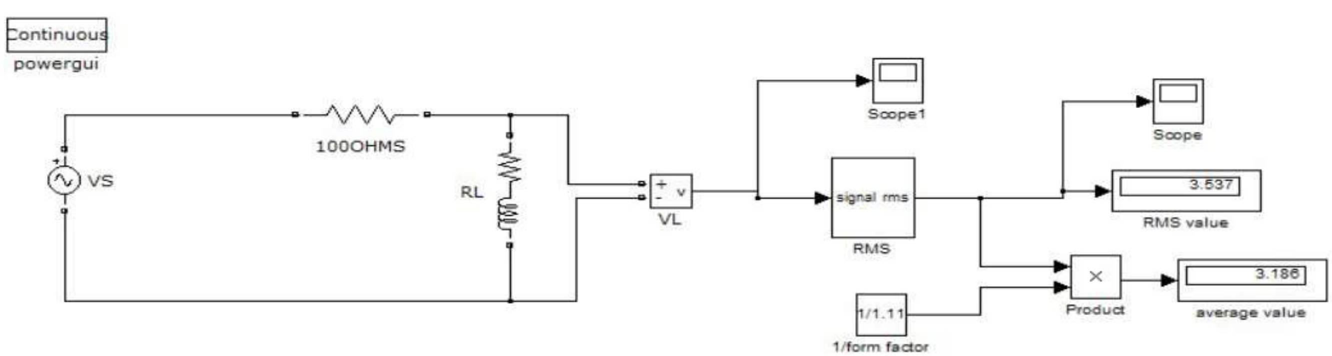

Fig – 4.2 MATLAB Simulink circuit

4.11 PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure the Peak value of the voltage obtained
3. Verify with the practical results obtained with theoretical results

4.12 OBSERVATIONS & CALCULATIONS:

Peak value (V)	RMS value (V)	Averagevalue (V)

4.13 RESULT:

4.14 PRE LAB VIVA QUESTIONS:

1. What is complex wave?
2. Define Instantaneous value.
3. Why RMS value is not calculated for DC quantity?
4. Define RMS Value.
5. What is the expression for form factor and peak factor?

4.15 POST LAB VIVA QUESTIONS:

1. What is RMS value of Sin wave?
2. Why RMS value is specified for alternating Quantity?
3. Why average value is calculated for half cycle for an sine wave?
4. Define form factor and peak factor for an alternating wave.

EXPERIMENT - 5

(A) VERIFICATION OF SUPERPOSITION THEOREM

5.1 AIM:

To Verify principle of Superposition theoretically and practically.

STATEMENT:

In an linear, bilateral network the response in any element is equal to sum of individual responses While all other sources are non-operative.

5.2 APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Resistors			
2.	Ammeter			
3.	R.P.S			
4.	Bread Board			
5.	Connecting Wires			required

5.3 CIRCUIT DIAGRAM:

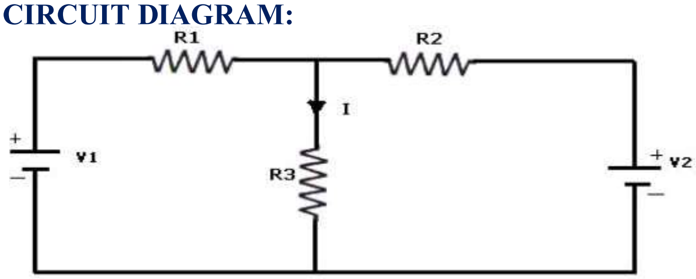

Fig- 5.1 Both Voltage Sources are acting (V_1&V_2)

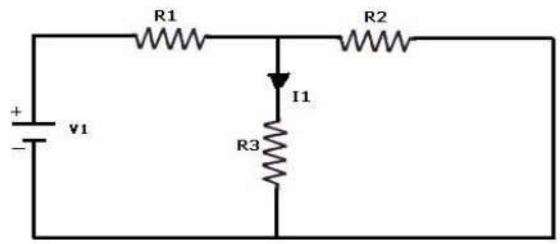

Fig - 5.2 Voltage Source V_1 is acting alone

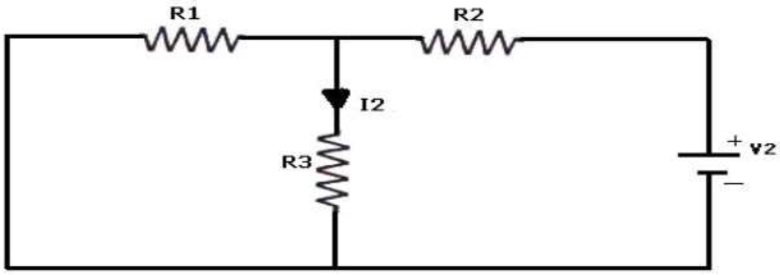

Fig - 5.3 Voltage Source V_2 is acting alone

5.4 PROCEDURE:

1. Connect the circuit as shown in figure (5.1) and note down the current flowing through R_3 and let it be I.
2. Connect the circuit as shown in figure (5.2) and note down the ammeter Reading, and let it be I_1.
3. Connect the circuit as shown in figure (5.3) and note down the ammeter reading, and let it be I_2.
4. Verify for $I=I_1+I_2$.

5. Compare the practical and theoretical currents.

5.5 TABULAR COLUMN:

PARAMETERS	WHEN BOTH V_1 & $V_2 \neq 0$ (I)	WHEN $V_1 \neq 0$ & $V_2=0$ (I_1)	WHEN $V_1=0$ & $V_2 \neq 0$ (I_2)
Current through R_3 (Theoretical Values)			
Current through R_3 (Practical Values)			

5.6 PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected

5.7 RESULT

(B)VERIFICATION OF SUPERPOSITION THEOREM USING DIGITAL SIMULATION.

5.8 AIM:

To verify Superposition theorem using digital simulation.

5.9 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

5.10 CIRCUIT DIAGRAMS:

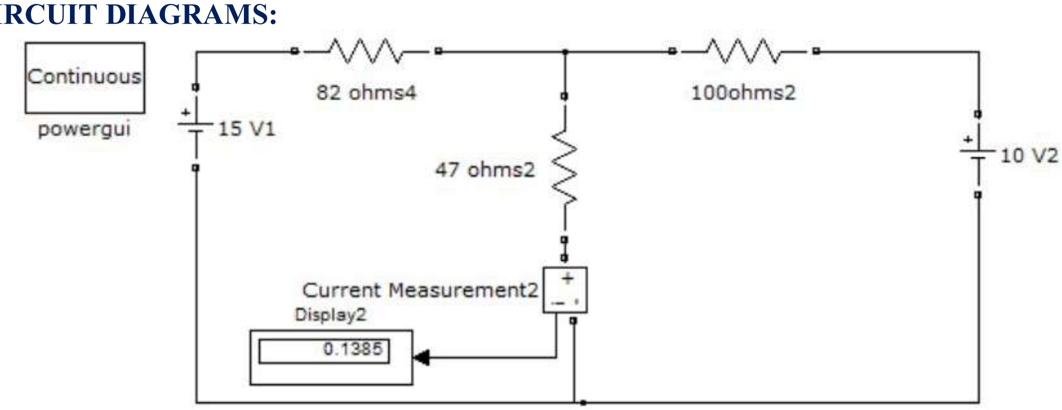

Figure – 5.4 Verification of super position theorem.

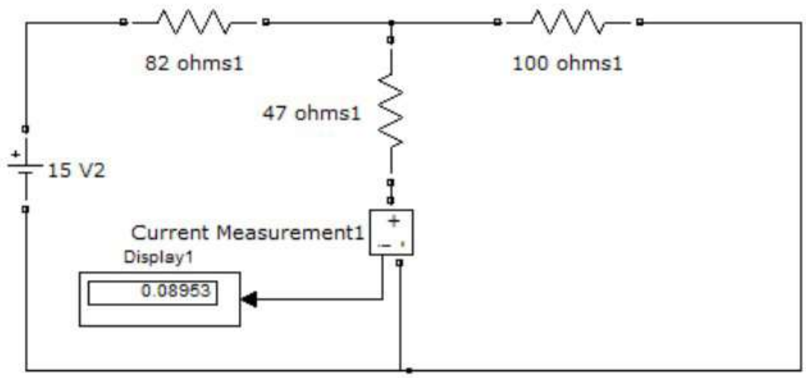

Figure – 5.5. Verification of super position theorem.

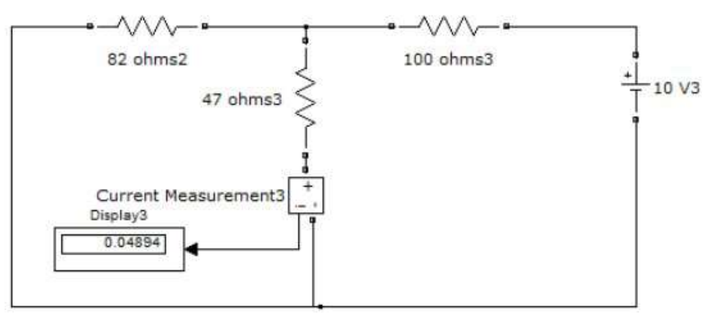

Figure – 5.6. Verification of super position theorem.

5.11 PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure the current in each circuit using current measurement.
3. Verify with the theoretical results obtained with practical results

5.12 RESULT:

5.13 PRE LAB VIVA QUESTIONS:

1. State Superposition theorem.
2. How to find power using Superposition theorem?
3. Write applications of super position theorem.

5.14 POST LAB VIVA QUESTIONS:

1. Is it possible to apply Superposition theorem to nonlinear circuit?
2. Is it possible to apply Superposition theorem to ac as well as dc circuit?