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ELECTRICAL CIRCUIT ANALYSIS LABORATORY

LAB MANUAL

Subject Code	:	AEEB06
Regulation	:	R18
Class	:	I YearII Semester
Branch	:	ECE
Year	:	2019- 2020

Department of Electrical and Electronics Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal – 500 043, Hyderabad

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ELECTRICAL AND ELECTRONICS ENGINEERING

Program Outcomes	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PO12	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
Program Specific Outcomes	
PSO1	**Professional Skills:**Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.
PSO2	**Problem-Solving Skills:**To explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.
PSO3	**Successful Career and Entrepreneurship:**To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test,and maintain power systems and industrial applications.

INDEX

ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Verification of Ohm's law, KVL and KCL using hardware and digital simulation.	PO1,PO5	-
2	Determination of mesh currents using hardware and digital simulation.	PO1,PO5	-
3	Measurement of nodal voltages using hardware and digital simulation.	PO1,PO5	-
4	Calculation of average value, RMS value, form factor, peak factor of sinusoidal wave using hardware.	PO1	-
5	Examine the impedance of series RL,RC,RLC Circuit	PO1	-
6	Verification of series resonance using hardware and digital simulation.	PO1,PO3,PO5	-
7	Verification of parallel resonance using hardware and digital simulation.	PO1,PO3,PO5	-
8	Verification of superposition theorem using hardware and digital simulation	PO1,PO2,PO5	-
9	Verification of reciprocity theorem using hardware and digital simulation.	PO1,PO2,PO5	-
10	Verification of maximum power transfer theorem using hardware and digital simulation.	PO1,PO2, PO3, PO5	-
11	Verification of Thevenin's theorem using hardware and digital simulation.	PO1,PO2,PO5	-
12	Verification of Norton's theorem using hardware and digital simulation.	PO1,PO2,PO5	-
13	Verification of compensation theorem using hardware and digital simulation.	PO1,PO2,PO5	-
14	Verification of Milliman's theorem using hardware and digital simulation.	PO1,PO2,PO5	-

ELECTRICAL CIRCUIT ANALYSIS LABORATORY

OBJECTIVE:

The objective of the Electrical Circuit Analysis lab is to expose the students to the electrical circuits and give them experimental skill. The purpose of lab experiment is to continue to build circuit construction skills using different circuit element. It also aims to introduce MATLAB a circuit simulation software tool. It enables the students to gain sufficient knowledge on the programming and simulation of Electrical circuits,

OUTCOMES:

Upon the completion of Electrical Circuit and simulation practical course, the student will be able to attain the following:

1. Familiarity with DC and AC circuit analysis techniques.
2. Analyze complicated circuits using different network theorems.
3. Acquire skills of using MATLAB software for electrical circuit studies.
4. Analysis of RLC resonant circuits.

EXPERIMENT - 1

VERIFICATION OF OHM'S LAW, KVL AND KCL USING HARDWARE AND DIGITAL SIMULATION

1.1 AIM

To verify Ohm's law for a given resistive network

1.2 APPARATUS REQUIRED

S. No	Apparatus Name	Range	Type	Quantity
1.	RPS	(0 – 30V)	Digital	01
2.	Ammeter	(0 – 200mA)	Digital	03
3.	Voltmeter	(0 – 30V)	Digital	03
4.	Resistor	unknown	Carbon	03
5.	Rheostat	(0-20k)	-	01
6.	Bread Board	-	-	01
7.	Connecting Wires	-	-	As required

1.3 CIRCUIT DIAGRAM

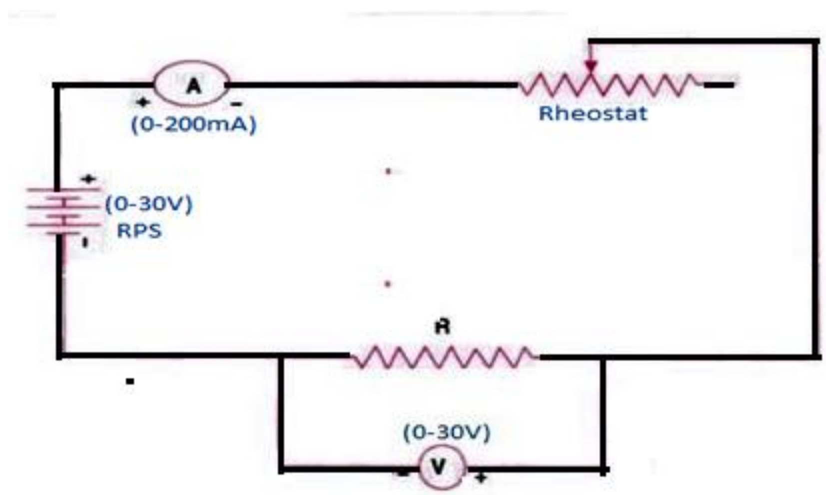


Figure – 1.1OHM'S law

1.4 PROCEDURE

1. Make the connections as per circuit diagram 1.1.
2. Switch ON the power supply to RPS and apply a voltage (say 10V) and take the reading of voltmeter and ammeter.
3. Adjust the rheostat in steps and take down the readings of ammeter and voltmeter.
4. Plot a graph with **V** along x-axis and **I** along y-axis.
5. The graph will be a straight line which verifies Ohm's law.
6. Determine the slope of the V-I graph. The reciprocal of the slope gives resistance of the wire.

1.5 OBSERVATIONS

S. No.	Voltage (V)	Current (mA)

1.6 MODEL GRAPH

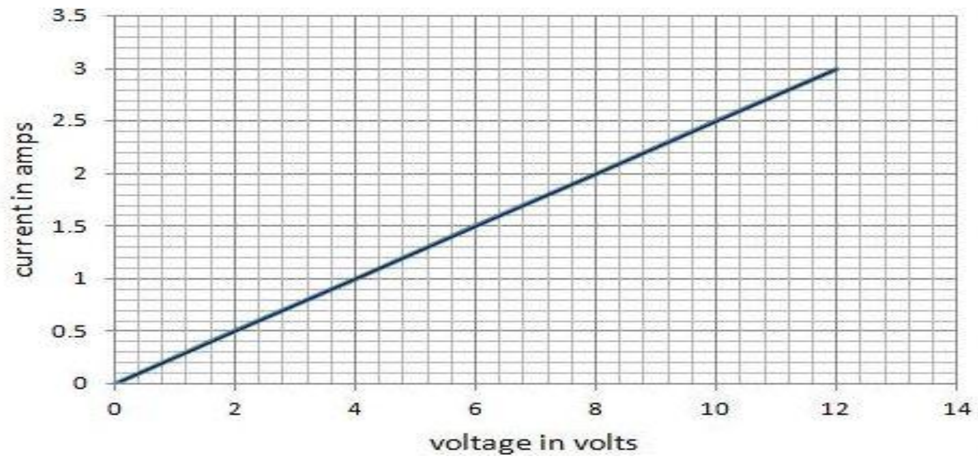


Figure – 1.2Voltage vs Current Graph

1.7 PRECAUTIONS

1. Take care to connect the ammeter and voltmeter with their correct polarity.
2. Make sure of proper color coding of resistors.
3. The terminal of the resistance should be properly connected.
4.

1.8 RESULT

1.9 PRE LAB QUESTION

1. What is current?
2. What is voltage?
3. Define charge.
4. Define power.
5. What is the resistance?
6. What is ohm's law?

1.10 POST LAB QUESTIONS

1. What do you mean by junction?
2. What is the colour coding of resistors?
3. What are the precautions to be taken while doing the experiment?
4. What is the range of ammeters and voltmeters you used in this experiment?
5. What are the limitations of ohm's law?
6. What is the condition of ohm's law?

VERIFICATION OF KVL AND KCL

1.11 AIM:

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

1.12 STATEMENT:

Kirchhoff's voltage law states that "The sum of all voltages or potential differences in an electrical circuit loop is 0".

$$\sum_k V_k = 0$$

Kirchhoff's Current Law (KCL) states that "The sum of all currents that enter an electrical circuit junction is 0". The currents enter the junction have positive sign and the currents that leave the junction have a negative sign.

$$\sum_k I_k = 0$$

1.13 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

1.14 CIRCUIT DIAGRAMS:

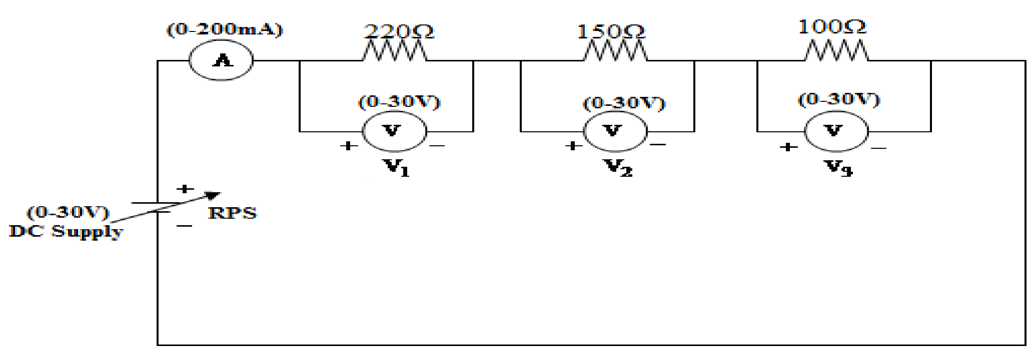


Figure – 1.3Verification of KVL

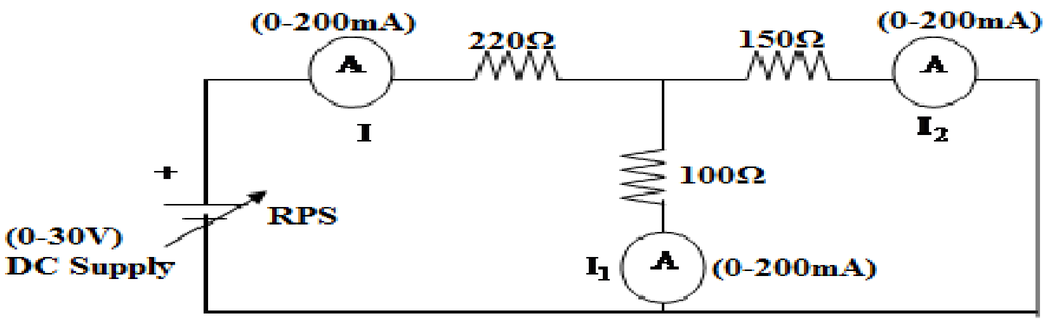


Figure – 1.4 Verification of KCL

1.15 PROCEDURE:

To Verify KVL

1. Connect the circuit diagram as shown in Figure 1.3
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 1.4.
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

1.16 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

1.17 PRECAUTIONS:

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

1.18 RESULT:

VERIFICATION OF KVL AND KCL USING DIGITAL SIMULATION

1.19 AIM:

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

1.20 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

1.21 CIRCUIT DIAGRAMS:

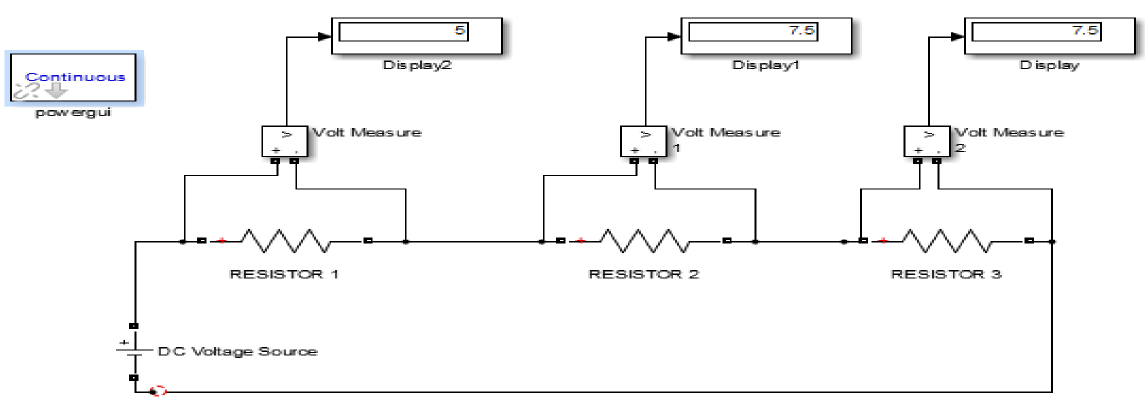


Figure – 1.3Verification of KVL

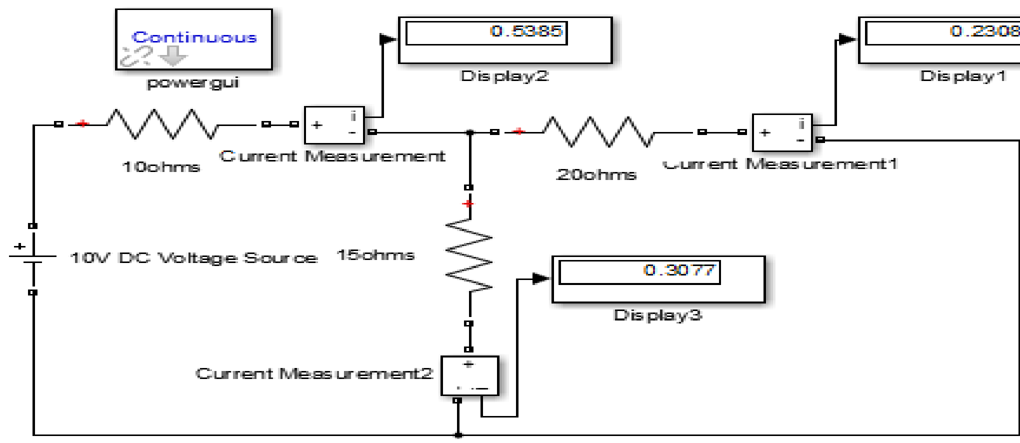


Figure – 1.4Verification of KCL

1.22 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.

1.23 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

1.24 RESULT:

1.25 PRE LABVIVA QUESTIONS:

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

1.26 POST LAB VIVA QUESTIONS:

1. What do you mean by junction?
2. Derive current division rule.
3. Explain the sign conventions.
4. Explain the colour 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 applicationis 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:

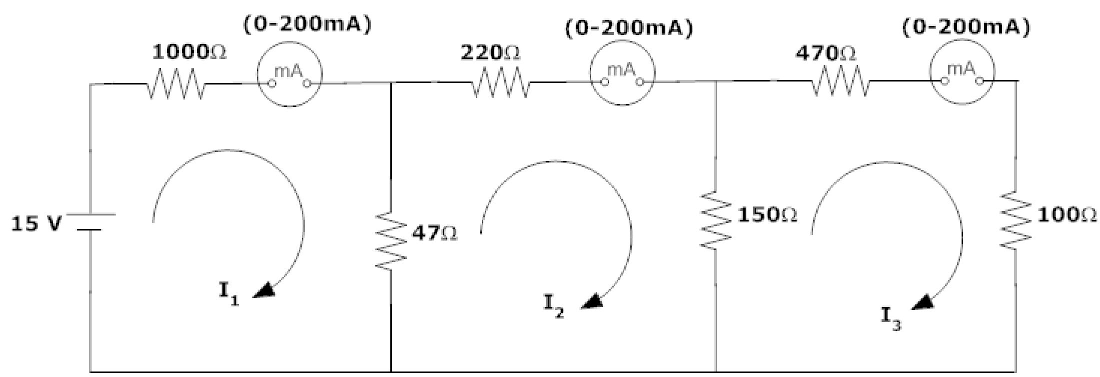


Figure – 2.1 Mesh analysis

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 with the theoretical results obtained with practical results

2.6 OBSERVATIONS:

Applied Voltage V (volts)	Loopcurrent(I_1)		Loopcurrent (I_2)		Loopcurrent(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 verifymesh analysis for an electrical circuit using digital simulation.

2.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	36

2.10 SIMULATION DIAGRAMS:

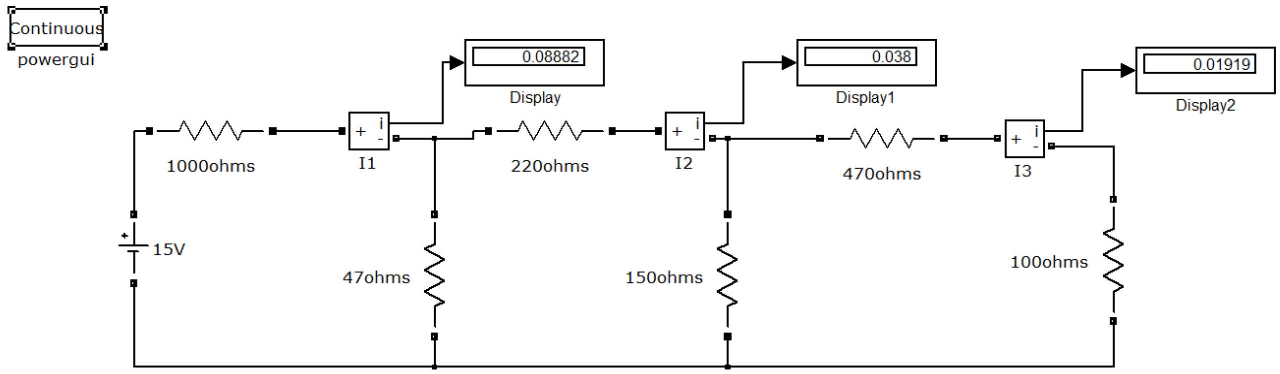


Figure – 2.2 Meshanalysis in MATLAB

2.11 PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure currents in each loop.
3. Verify with the theoretical results obtained with simulation results.

2.12 OBSERVATIONS:

Applied Voltage V (volts)	Loopcurrent(I_1)		Loopcurrent (I_2)		Loopcurrent(I_3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

2.13 RESULT

2.14 PRE LABVIVA QUESTIONS:

1. Mesh analysis is based on_____________?
2. Explain mesh analysis?
3. Mention the application of 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.	Regulated Power Supply Units			
4.	Bread Board	-	-	
5.	Connecting Wires			required

3.3 THEORY:

In electric circuitanalysis, 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:

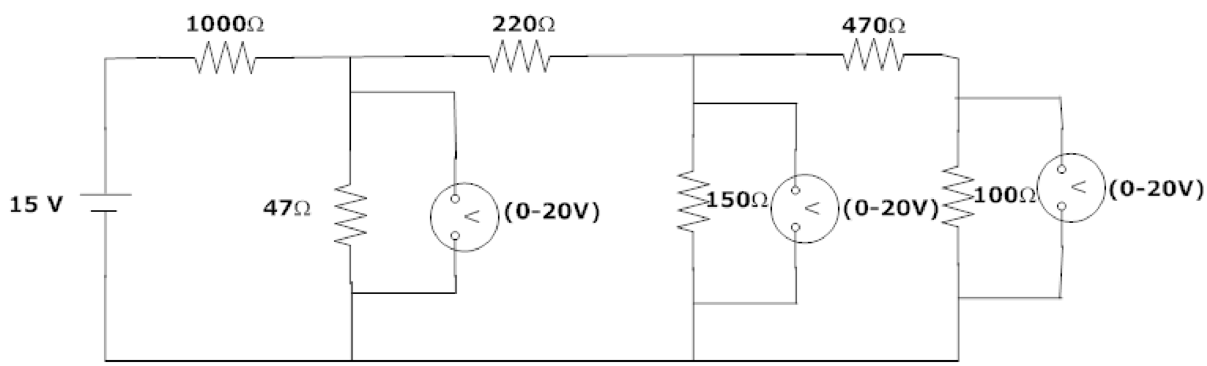


Figure 3.1 Nodal Analysis

3.5 PROCEDURE

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 with the theoretical results obtained with practical 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

AIM:

To verifynodal analysisfor an electrical circuit using digital simulation.

3.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	36

3.10 SIMULATION DIAGRAMS:

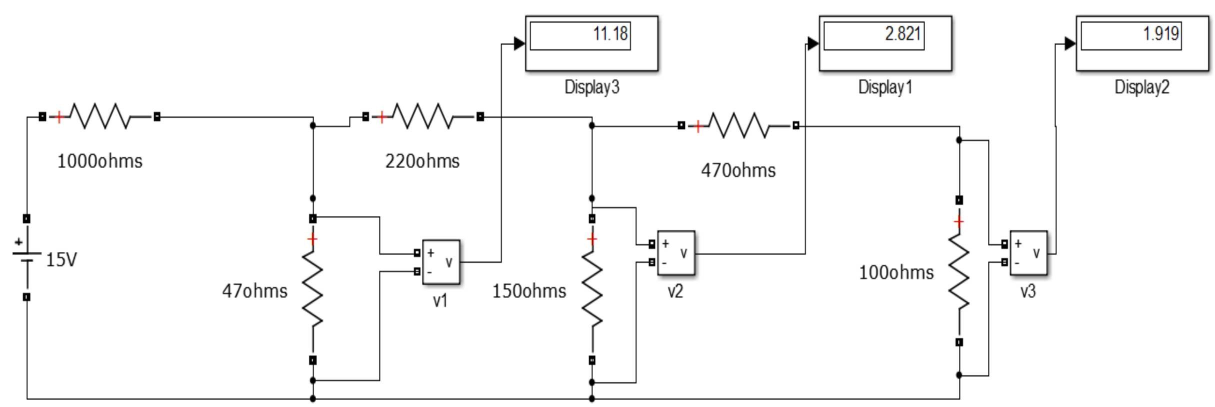


Figure – 3.2 Nodalanalysis in MATLAB

3.11 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 the theoretical node voltages obtained with practical values.

3.12 OBSERVATIONS:

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

3.13 RESULT:

3.14 PRE LABVIVA QUESTIONS:

1. Name the laws on which nodal analysis based?
2. Explain nodal analysis?
3. Give the necessary conditions for applying the super node analysis?

3.15 POST LAB VIVA QUESTIONS:

1. Define node.
2. Is nodal analysis is applicable to both DC and AC supply?
3. How to calculate branch currents from nodal voltages?
4. How to calculate branch voltages from nodal voltages?

EXPERIMENT - 4

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

4.1 AIM:

To determinethe 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 No.s
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.

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

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:

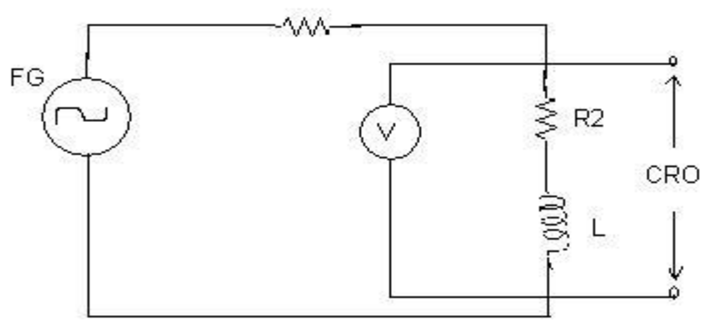


Fig – 4.1 Basic Circuit

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 setit into DC mode.
4. Connect CRO across the load in DC mode and observe the waveform. Adjustthe DC offset of function generator.
5. Note down the amplitude and frequency.
6. Set the multimeter into AC mode and measure input voltage and voltageacross 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 peakvoltage.
9. Measure the RMS and Average value of DC signal also where instead offunction generator you can use DC supply.

4.5 OBSERVATIONS & CALCULATIONS:

Peak Value(V)	RMS Value(V)	AverageValue(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 determinethe average value, RMS value, form factor, peak factor of sinusoidal wave, square wave.

4.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	36

4.10 CIRCUIT DIAGRAM:

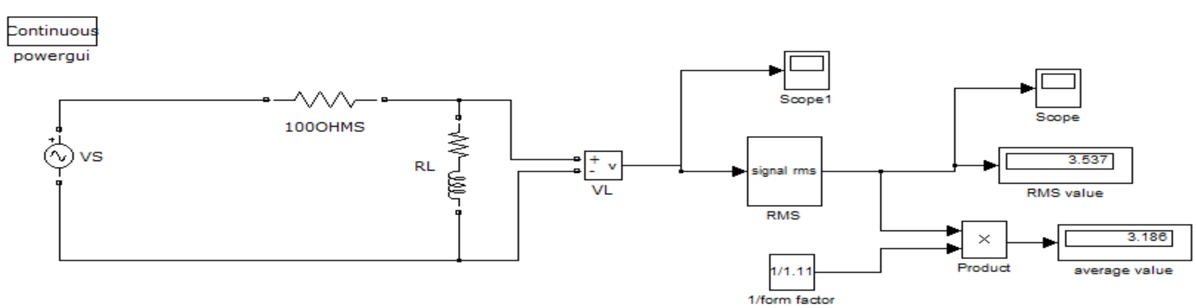


Figure 4.2MATLAB Simulink circuit

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 theoretical results obtained with practical 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 a sine wave?
4. Define form factor and peak factor for an alternating wave.

EXPERIMENT - 5

IMPEDANCE OF SERIES RL,RC, RLC CIRCUITS

5.1 AIM:

Examine the impedance of series RL,RC,RLC Circuit.

5.2 APPARATUS:

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

5.3 CIRCUIT DIAGRAM:

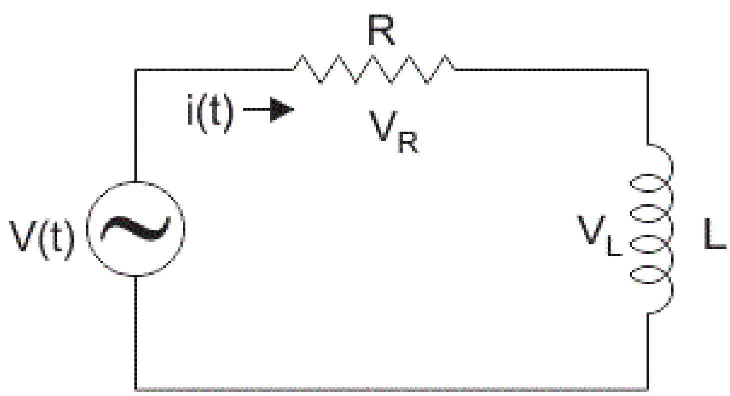


Figure 5.1

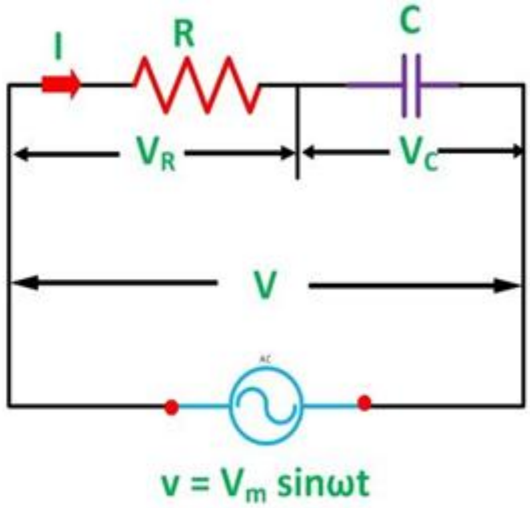


Figure 5.2

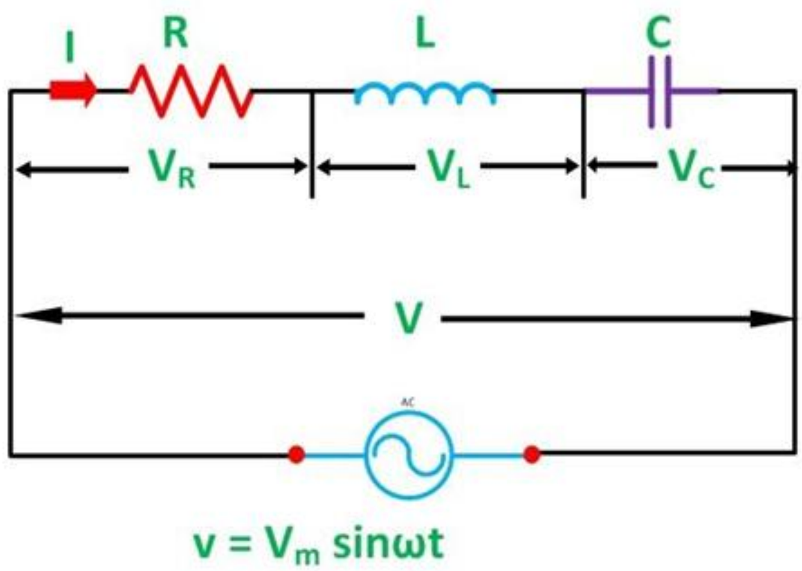


Figure 5.3

5.4 PROCEDURE:

1. Connect the circuit as shown in the circuit diagram of fig. 5.1
2. Check for proper connections before switching ON the supply
3. Using figure 5.1 with E , R , and L Measure the current and voltage flowing throw resistor and inductor .
4. Calculate the impedance value of RL circuit theoretically practically

5.5 TABULARCOLUMN:

V_R(VOLTS)	V_L (VOLTS)	I(AMPS)	IMPEDANCE

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 and inductor should be properly connected

5.7 PRE LAB VIVA QUESTIONS:

1. Define inductor.
2. Define resistor?
3. Write applications of series RL circuits.

5.8 POST LAB VIVA QUESTIONS:

1. Inductor does not allow sudden change of current, why?
2. Define initial conditions of passive elements?

5.9 RESULT

EXPERIMENT - 6

(A) VERIFICATION OF SERIES RESONANCE

6.1 AIM:

To design the resonant frequency, quality factor and band width of a series resonant circuit

6.2 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Signal generator			
2	Requiredresistors			
3	Required Inductors			
4	Requiredcapacitors			
5	CRO probes			
6	Connecting wires			

6.3 CIRCUITDIAGRAM:

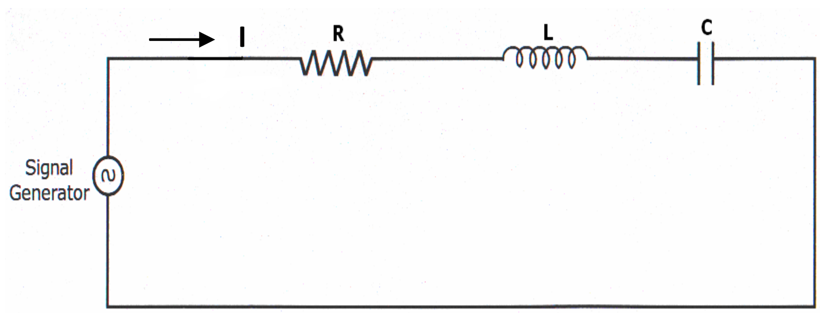


Fig – 6.1 Series Resonance

6.4 PROCEDURE:

1. Connect the circuit as shown in fig.6.1.
2. Set the voltage of the signal from function generator to10V.
3. Vary the frequency of the signal in steps and note down the magnitude of response on CRO respectively (response wave form is observed across element R).
4. Form the observation table between the frequency and magnitude of response in CRO firstly for series resonance circuit.
5. Draw a graph between frequency and magnitude of response on the semi-log sheet and determine the resonant frequency, quality factor and bandwidth for seriescircuit.

6.5 THEORETICAL CALCULATIONS:

SeriesResonance

Resonant Frequency $(f_r)=1/(2\pi\sqrt{LC})$ Lower

cut offfrequency $(f_1) = fr - R/4\pi L$

Upper cutofffrequency $(f_2) = fr + R/4\pi L$

Qualityfactor $Q_r = \omega_r L/R = 1/\omega_r RC$

Band Width $f_2 - f_1 = R/2\pi L$

6.6 TABULARCOLUMN:

S.No.	Frequency *(Hz)*	Magnitude of response
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

6.7 MODELGRAPH:

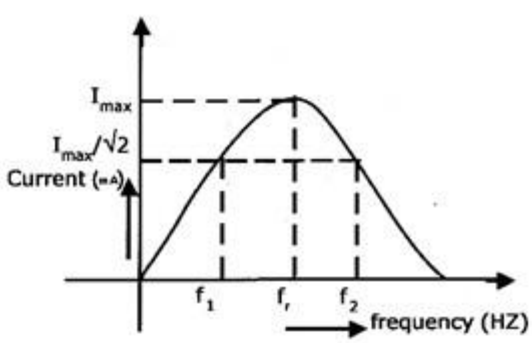


Fig – 6.2SeriesResonance

6.8 RESULT:

(B) DESIGN AND SIMULATION OF SERIES RESONANCE CIRCUIT.

6.9 AIM:

To plot the magnitude curve for various frequencies for thegiven RLC series circuit.

6.10 SOFTWARE REQUIRED:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

6.11 THEORY:

A circuit is said to be in resonance when applied voltage V and current I are inphase with each other. Thus at resonance condition, the equivalent compleximpedance of the circuit consists of only resistance (R) and hence current ismaximum. Since V and I are in phase, the power factor is unity.

The complex impedance

$Z = R + j\,(XL - XC)$

Where $XL = \omega L$

$XC = 1/\omega C$

At resonance, XL= XC and hence Z= R

Bandwidth of a Resonance Circuit:

Bandwidth of a circuit is given by the band of frequencies which lies betweentwo points on either side of resonance frequency, where current falls through 1/1.414of the maximum value of resonance. Narrow is the bandwidth, higher the selectivityof the circuit. As shown in the model graph, the bandwidth AB is given by f2 – f1. f1 isthe lower cut off frequency and f2 is the upper cut off frequency

6.12 CIRCUIT DIAGRAM:

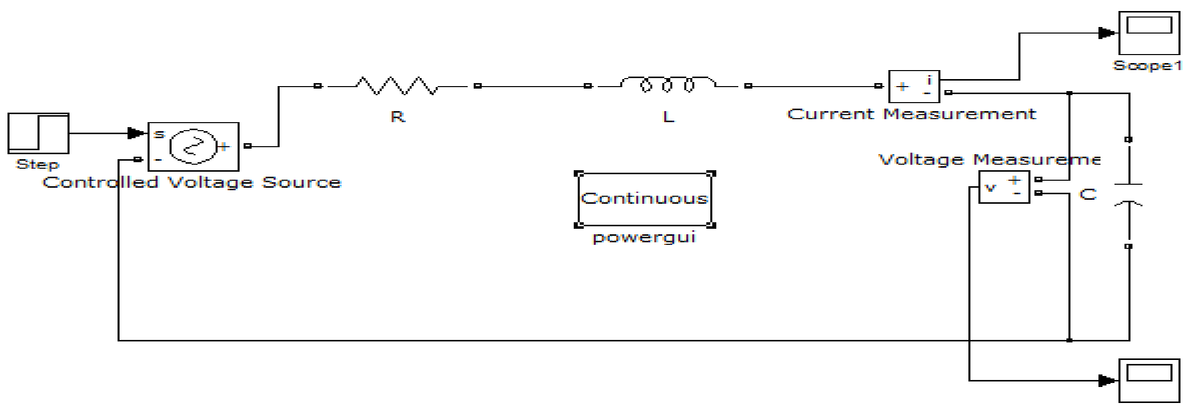


Fig – 6.3 Series Resonance simulation diagram

6.13 PROCEDURE:

1. Open a new MATLAB/SIMULINK model.
2. Connect the circuit as shown in the figure6.3.
3. Run the simulation.
4. By double clicking the powergui, plot the value of current for the different values of frequencies.

6.14 MODEL GRAPH FOR SERIES RESONANCE

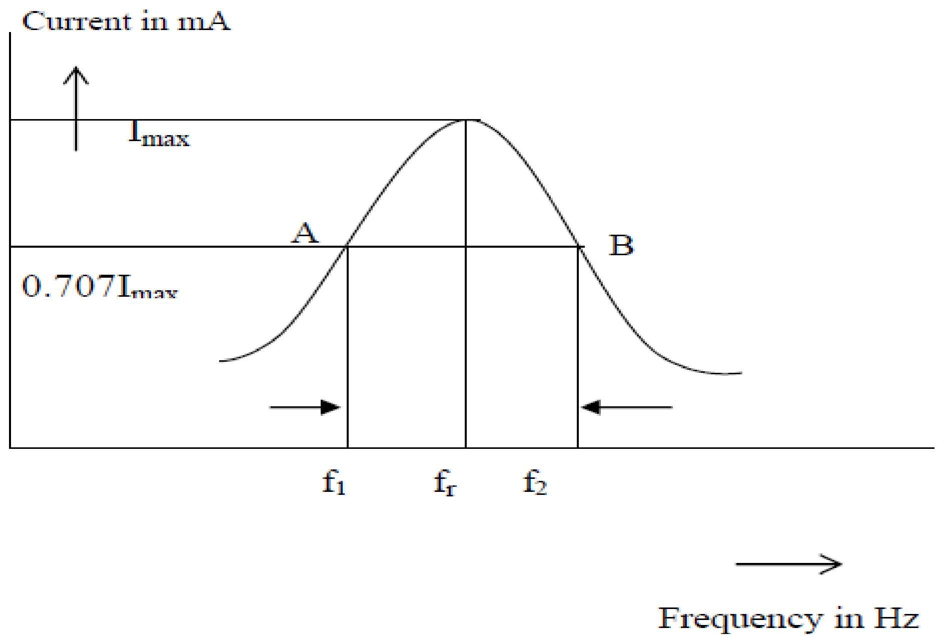


Fig – 6.4 Series Resonance Model graph

6.14 %PROGRAM TO FIND THE SERIES RESONANCE

```
clc;
clearall;
closeall;
r=input('enter the resistance value----->');
l=input('enter the inductance value------>');
c=input('enter the capacitance value----->');
v=input('enter the input voltage------->');
f=5:2:300;
xl=2*pi*f*l;
xc=(1./(2*pi*f*c));
x=xl-xc;
z=sqrt((r^2)+(x.^2));
i=v./z;
%plotting the graph
subplot(2,2,1);
plot(f,xl);
```

```
grid;
xlabel('frequency');
ylabel('X1');
subplot(2,2,2);
plot(f,xc);
grid;
xlabel('frequency');
ylabel('Xc');
subplot(2,2,3);
plot(f,z);
grid;
xlabel('frequency');
ylabel('Z');
subplot(2,2,4);
plot(f,i);
grid;
xlabel('frequency');
ylabel('I');
```

6.15 PROGRAM RESULT:

enter the resistance value----->100

enter the inductance value------>10e-3

enter the capacitance value----->0.1*10^-6

enter the input voltage------->10

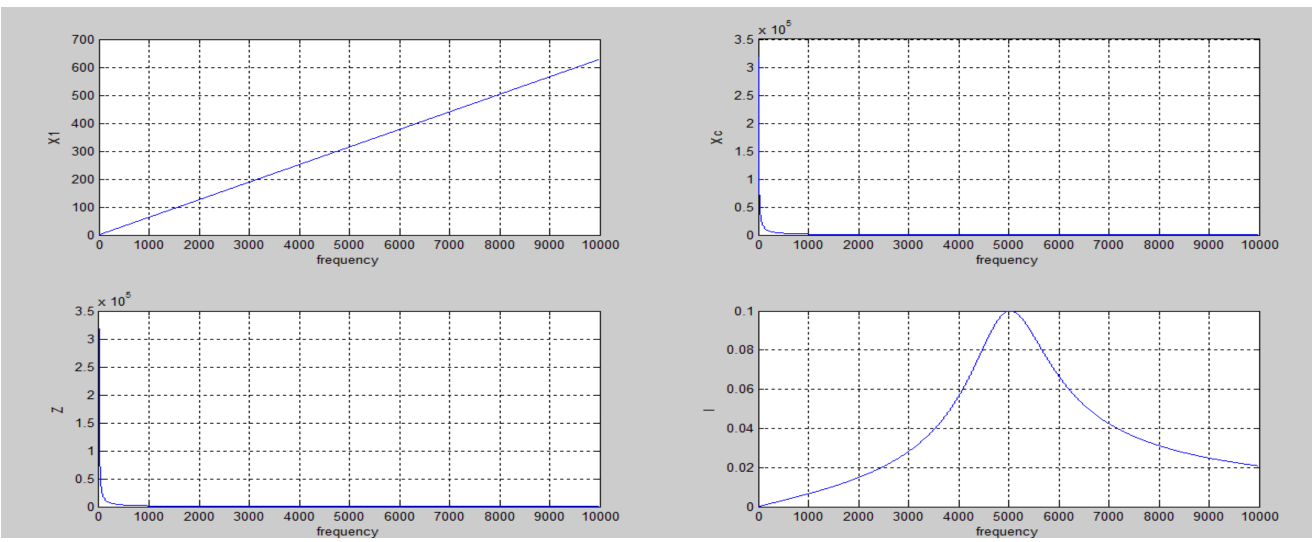


Fig – 6.5 MATLAB results

6.16 PRE LAB VIVAQUESTIONS:

1. Define resonance.
2. Give condition for seriesresonance.
3. Define bandwidth.
4. Define qualityfactor.
5. What is the importance of qualityfactor?

6.17 LABASSIGNMENT:

1. Give the expression forquality factor.
2. Give the application of series resonancecircuit.

6.18 POST LAB VIVAQUESTIONS:

1. Define series resonance.
2. Define magnification.
3. What is power factor under resonantcondition?

EXPERIMENT – 7

(A) VERIFICATION OF PARALLEL RESONANCE

7.1 AIM:

To design the resonant frequency, quality factor and band width of a parallel resonant circuit.

7.2 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Signal generator			
2	Requiredresistors			
3	Required Inductors			
4	Requiredcapacitors			
5	CRO probes			
6	Connecting wires			

7.3 CIRCUITDIAGRAM:

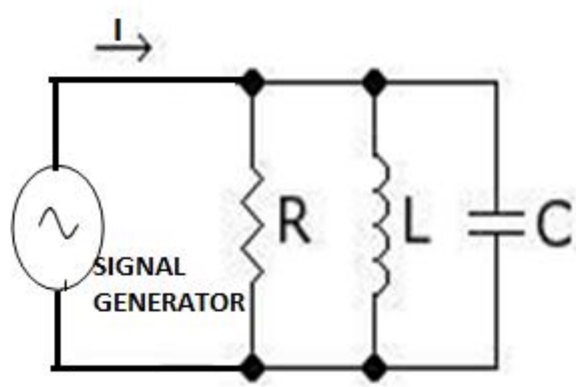


Fig – 7.1 Parallel Resonance

7.4 PROCEDURE:

1. Connect the circuit as shown in fig.7.1 for parallel resonantcircuit.
2. Set the voltage of the signal from function generator to10V.
3. Vary the frequency of the signal in steps and note down the magnitude of response on CRO respectively (response wave form is observed across element R)
4. Form the observation table between the frequency and magnitude of response in CRO for parallel resonancecircuit.
5. Draw a graph between frequency and magnitude of response on the semi-log sheet and determine the resonant frequency, quality factor and bandwidth for parallel resonancecircuit.

7.5 THEORETICAL CALCULATIONS:

Parallel Resonance

Resonant Frequency $(f_r) = 1/(2\pi\sqrt{LC})$

Lower cut offfrequency $(f_1)=f_r-1/4\pi RC$ Upper

cutofffrequency $(f_2)=f_r+1/4\pi RC$

Qualityfactor $Q_r = \omega_r CR = f_r/B.W$

Band Width $f_2-f_1=1/2\pi RC$

7.6 TABULARCOLUMN:

S.No.	Frequency (Hz)	Magnitude of response
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

7.7 MODELGRAPH:

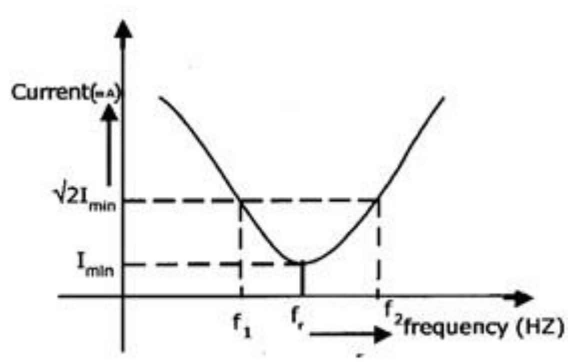


Fig – 7.2. ParallelResonance

7.8 RESULT

(B) DESIGN AND SIMULATION OF PARALLEL RESONANCE CIRCUIT.

7.9 AIM:

To plot the magnitude of current for various frequencies for the given RLC parallel circuit.

7.10 SOFTWARE REQUIRED:

S No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	36

7.11 THEORY:

A circuit is said to be in resonance when applied voltage V and current I are in phase with each other. Thus at resonance condition, the equivalent complex impedance of the circuit consists of only resistance (R) and hence current is maximum. Since V and I are in phase, the power factor is unity. The complex impedance

$Z = R + j(X_L - X_C)$

Where $X_L = \omega L$

$X_C = 1/\omega C$

At resonance, $X_L = X_C$ and hence $Z = R$

Bandwidth of a Resonance Circuit:

Bandwidth of a circuit is given by the band of frequencies which lies between two points on either side of resonance frequency, where current falls through 1/1.414 of the maximum value of resonance. Narrow is the bandwidth, higher the selectivity of the circuit. As shown in the model graph, the bandwidth AB is given by $f_2 - f_1$. f_1 is the lower cut off frequency and f_2 is the upper cut off frequency.

7.12 PROCEDURE:

1. Open a new MATLAB/SIMULINK model.
2. Connect the circuit as shown in the figure 7.3.
3. Simulate the circuit.
4. By double clicking the powergui, plot the value of current for the different values of frequencies.

7.13 SIMULATION DIAGRAM FOR PARALLEL RESONANCE:

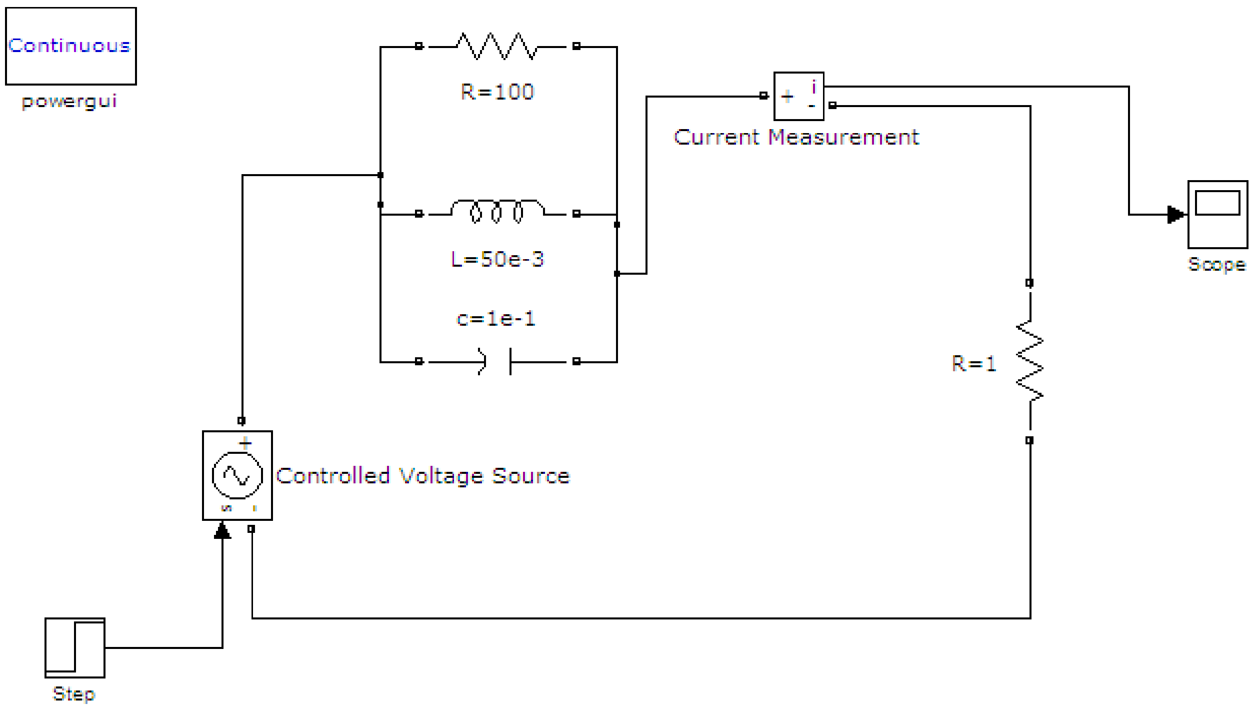


Fig – 7.3 Parallel Resonance

7.14 MODEL GRAPH FOR PARALLEL RESONANCE

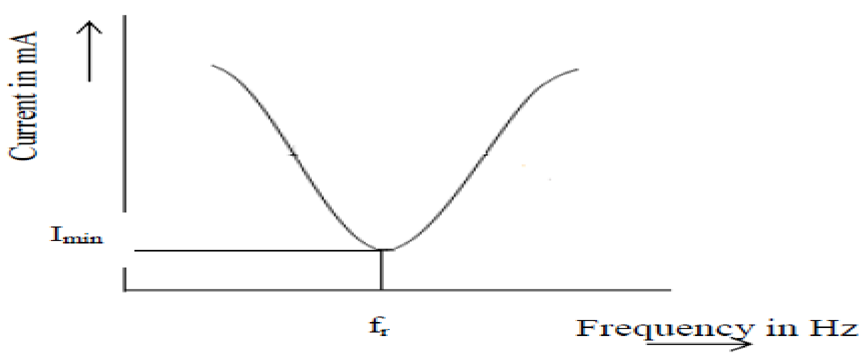


Fig – 7.4 Parallel Resonance

To obtain the graphs of frequency vs. BL , frequencyvs. BC , frequency vs. admittance and frequency vs. current vary frequency in steps for the given circuitand find the resonant frequency and check by theoretical calculations.

R = 1000W, C = 400 m F, L = 1 H, V = 50V vary frequency in steps of 1 Hz using MATLAB.

7.15 %PROGRAM TO FIND THE PARALLEL RESONANCE

```
clc;
clearall;
closeall;
r=input('enter the resistance value----->');
l=input('enter the inductance value------>');
c=input('enter the capacitance value----->');
v=input('enter the input voltage------->');
f=0:2:50;
xl=2*pi*f*l;
xc=(1./(2*pi*f*c));
b1=1./xl;
bc=1./xc;
b=b1-bc;
g=1/r;
y=sqrt((g^2)+(b.^2));
i=v*y;
%plotting the graph
subplot(2,2,1);
plot(f,b1);
grid;
xlabel('frequency');
ylabel('B1');
subplot(2,2,2);
plot(f,bc);
grid;
xlabel('frequency');
ylabel('Bc');
subplot(2,2,3);
plot(f,y);
grid;
xlabel('frequency');
ylabel('Y');
subplot(2,2,4);
plot(f,i);
grid;
```

```
xlabel('frequency');
ylabel('I');
```

7.16 PRE LAB VIVAQUESTIONS:

1. Define parallelresonance.
2. Give condition for parallelresonance.
3. Define bandwidth.
4. Define qualityfactor.
5. What is importance of qualityfactor?

7.17 LABASSIGNMENT:

1. Give the expression forband width.
2. Give the application of parallel resonancecircuit.

7.18 POST LAB VIVAQUESTIONS:

1. What is the difference between series and parallelresonance?
2. What do you observe from the parallel resonancegraphs?

XPERIMENT – 8

(A) VERIFICATION OF SUPERPOSITION THEOREM

8.1 AIM:

To verifyprinciple of Superposition theorem for an electrical circuit theoretically and practically.

STATEMENT:

In a linear, bilateral network the response in any element is equal to sum of individual responses While all othersources arenon-operative.

8.2 APPARATUS:

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

8.3 CIRCUIT DIAGRAM:

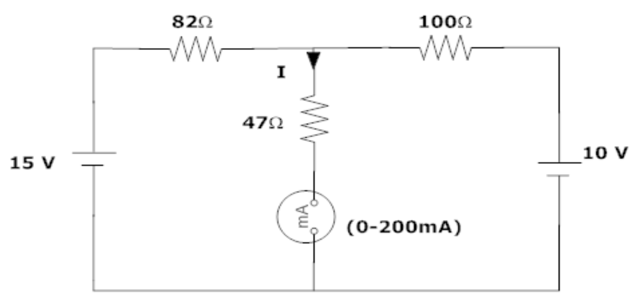


Fig- 8.1 Both Voltage Sources are acting (V_1&V_2)

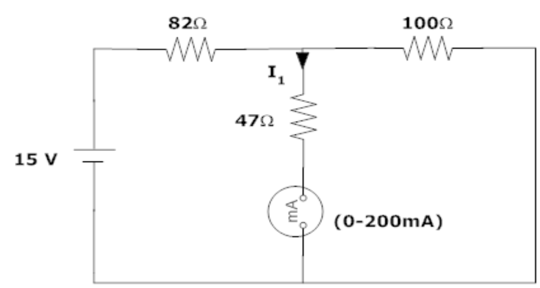


Fig -8.2 Voltage Source V_1 is acting alone

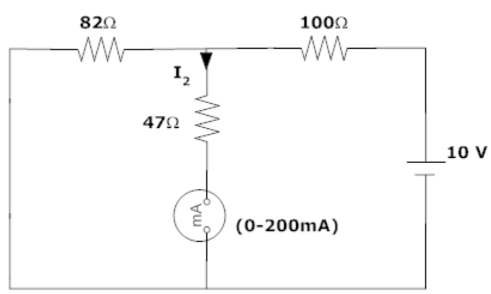


Fig - 8.3 Voltage Source V_2 is acting alone

8.4 PROCEDURE:

1. Connect the circuit as shown in figure (8.1) and note down the current flowing through R_3 and let it be I.
2. Connect the circuit as shown in figure (8.2) and note down the ammeter Reading, and let it be I_1.
3. Connect the circuit as shown in figure (8.3) 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.

8.5 TABULARCOLUMN:

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)			

8.6 PRECAUTIONS:

4. Check for proper connections before switching ON the supply
5. Make sure of proper color coding of resistors
6. The terminal of the resistance should be properly connected

8.7 RESULT

(C) VERIFICATION OFSUPERPOSITION THEOREM USING DIGITAL SIMULATION

8.8 AIM:

To verifySuperposition theorem for an electrical circuit using digital simulation.

8.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	36

8.10 CIRCUIT DIAGRAMS:

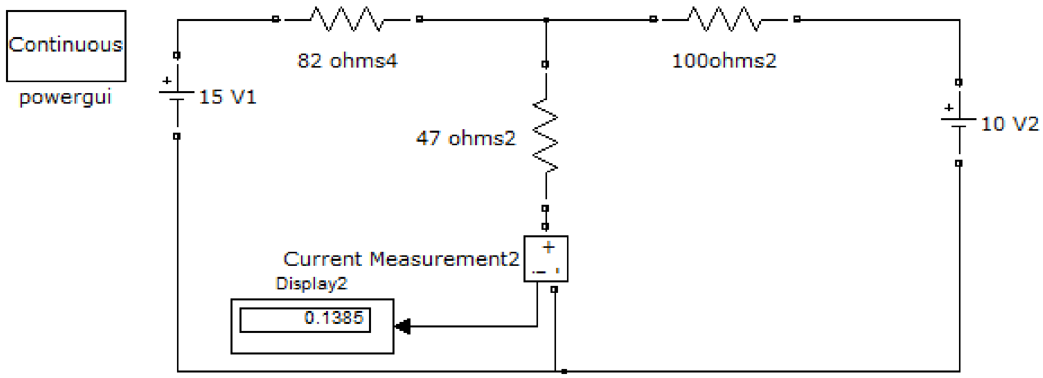


Figure – 8.4 Verification of super position theorem.

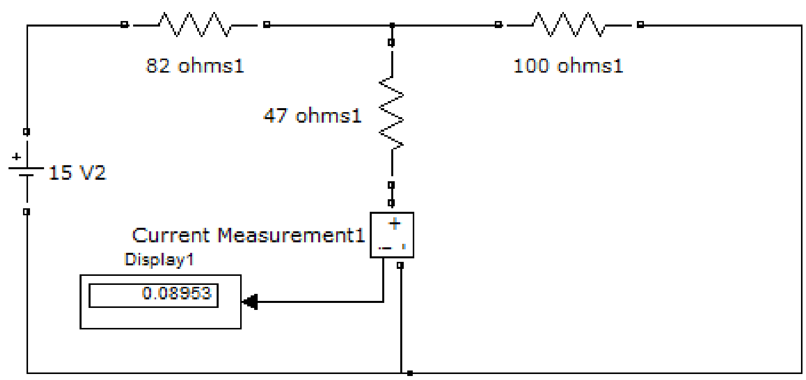


Figure – 8.5.Verification of super position theorem.

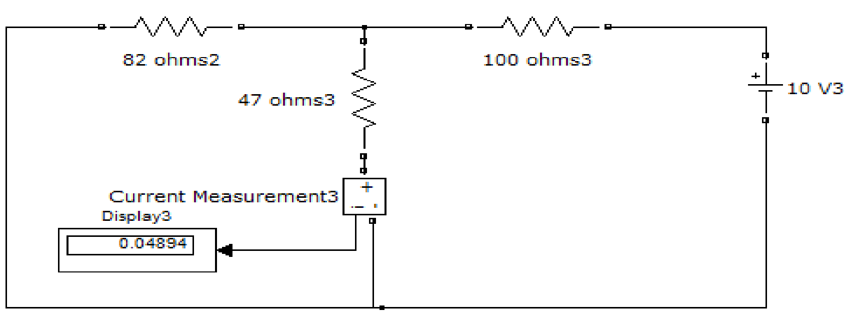


Figure – 8.6.Verification of super position theorem.

8.11 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

8.12 RESULT:

8.13 PRE LAB VIVA QUESTIONS:

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

8.14 POST LAB VIVA QUESTIONS:

3. Is it possible to apply Superposition theorem to nonlinear circuit?
4. Is it possible to apply Superposition theorem to ac as well as dc circuit?

EXPERIMENT – 9

(A)VERIFICATION OF RECIPROCITY THEOREM

9.1 AIM:

To verify thecondition of Reciprocityfor an electric network theoretically and practically.

9.2 STATEMENT

In any linear, bilateral, single source network the ratio of excitation to response is constant even when their positions are inter - changed.

9.3 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Ammeter			
2	Voltmeter			
3	R.P.S			
4	Resistors			
5	Bread Board			
6	Connecting Wires			

CIRCUITDIAGRAM:

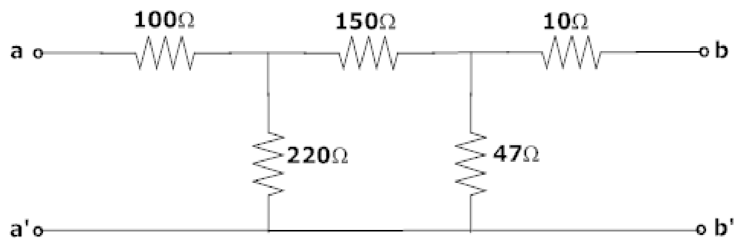


Fig - 9.1 Basic Circuit

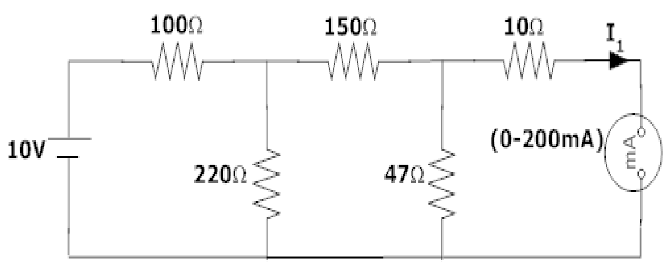


Fig – 9.2 Response due to 10v before interchanging load

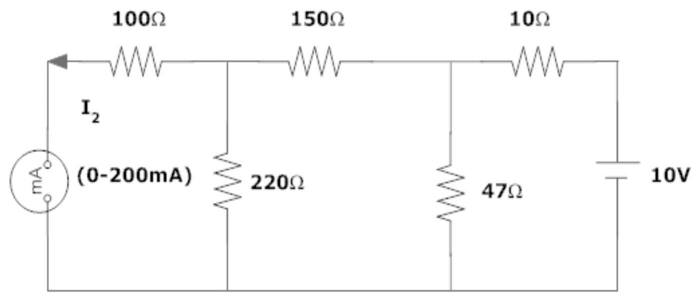


Fig – 9.3 Response due to 10v after interchanging load

9.4 PROCEDURE:

1. Connect the circuit as shown infig 9.2.
2. Measure the current I_1 in thebranch.
3. Inter - change voltage source and response as shown in fig 9.3 and note down the currentI_2.
4. Observe that the currents I_1 and I_2 should besame.
5. Measure the ratio of excitation and response and check whether they are equal in bothcases arenot.

9.5 TABULARCOLUMN:

Parameters	Theoretical Values	Practical Values

9.6 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

9.7 RESULT

(B) VERIFICATION OF RECIPROCITY THEOREM USING DIGITAL SIMULATION.

9.8 AIM:

To verify Reciprocity theorem for an electrical circuit using digital simulation.

9.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	36

9.10 CIRCUIT DIAGRAMS:

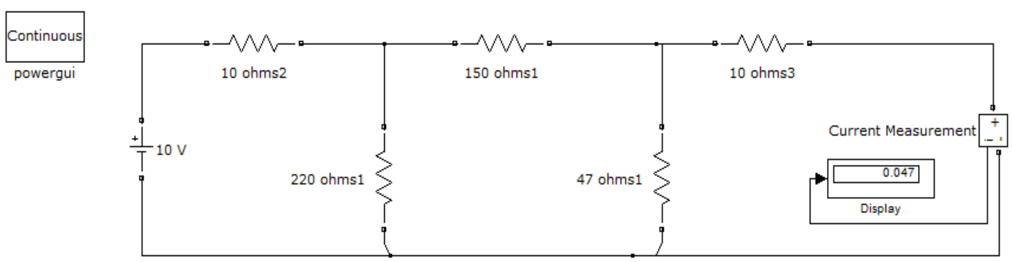


Fig – 9.4 Response due to 10v before interchanging load

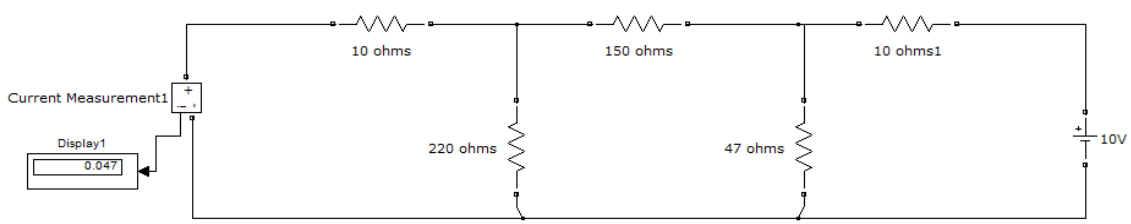


Fig – 9.5 Response due to 10v after interchanging load

9.11 PROCEDURE:

1. Make the connections as shown in the circuitdiagrams9.4&9.5 by using MATLAB Simulink.
2. Measure response current in the resistor in 10 ohms circuit-9.4.
3. Measure response current in the resistor in 10 ohms circuit-9.5.
4. Verify with the theoretical results obtained with practical results

9.12 PRE LAB VIVAQUESTIONS:

1. State reciprocitytheorem.
2. Is it possible to apply both theorems to ac as well as dccircuit?
3. Is Reciprocity is applicable for unilateral and bilateralnetworks?

9.13 LABASSIGNMENT:

1. State and prove reciprocitytheorem.
2. State applications of reciprocitytheorem.

9.14 POST LAB VIVAQUESTIONS:

1. Comment on the applicability of reciprocity theorem on the type ofnetwork.
2. Is reciprocity theorem is applicable to nonlinear circuits?

EXPERIMENT – 10

(A)VERIFICATION OF MAXIMUM POWER TRANSFER THEOREM

10.1 AIM:

To design the load resistor that absorbs maximum power from source.

10.2 STATEMENT:

The maximum power transfer theorem states that maximum power is delivered from a source to a load when the load resistance is equal to source resistance. (R_L= $R_S$is the condition required for maximum power transfer).

10.3 CIRCUITDIAGRAM:

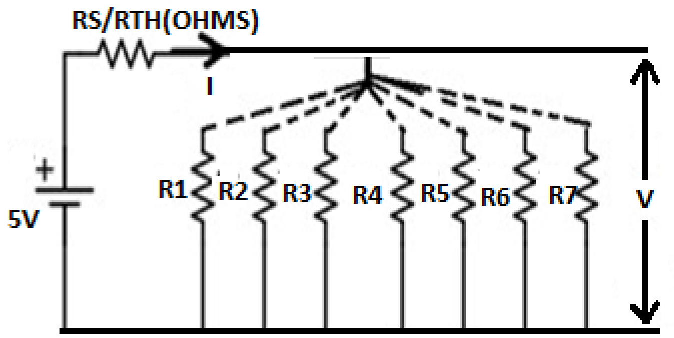


Fig – 10.1 Maximum Power Transfer Circuit

10.4 PROCEDURE:

1. Connect the circuit as shown infig.10.1
2. Vary the load resistance in steps and note down voltage across the load and current flowing through the circuit.
3. Calculate power delivered to the load by using formulaP=V*I.
4. Draw the graph between resistance and power (resistance on X- axis and power onY-axis).
5. Verify the maximum power delivered to the load when R_L= R_S forDC.

10.5 TABULARCOLUMN:

S. No	R	V	I	P
1				
2				
3				
4				
5				

10.6 MODELGRAPH:

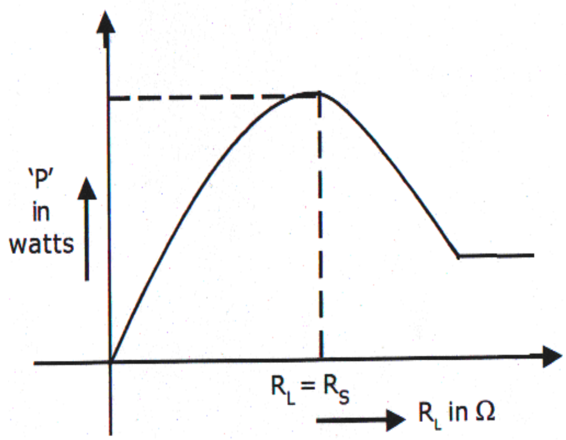


Fig – 10.2 Output Graph of Maximum Power Transfer Theorem

10.7 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.

10.8 RESULT

(B)VERIFICATION OF MAXIMUM POWER TRANSFER THEOREM

10.9 AIM:

To verify maximum power transfer theorem for an electrical circuit using digital simulation.

10.10 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

10.11 CIRCUIT DIAGRAMS

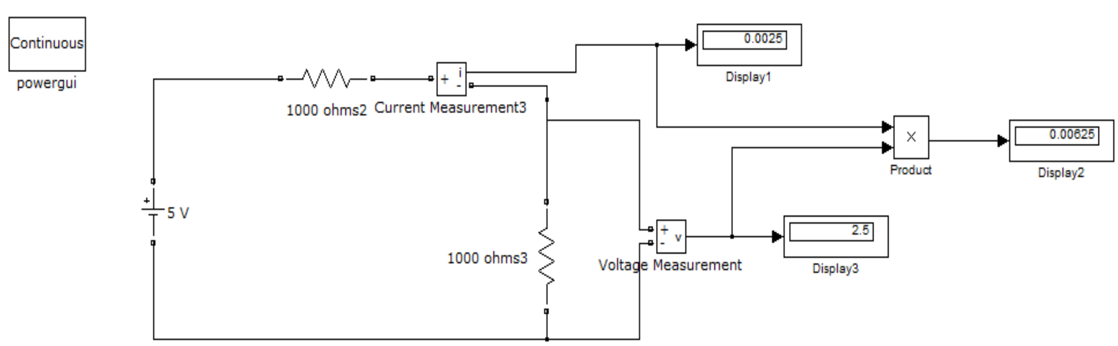


Fig – 10.3 Maximum Power Transfer Circuit

10.12 PROCEDURE:

1. Make the connections as shown in Fig 10.3 using MATLAB Simulink.
2. Measure the voltage and current through the load resistor using voltage measurement and current measurement blocks.
3. Calculate the power.
4. Find the resistance at which maximum power delivered

10.13 RESULT:

10.14 PRE LAB VIVAQUESTIONS:

1. State maximum power transfertheorem.
2. Is it possible to apply maximum power transfertheorem to ac as well as dccircuit?
3. How to find power using maximum power transfer theorem?

10.15 LABASSIGNMENT:

1. State and prove maximum power transfertheorem for dc circuit.
2. State and prove maximum power transfertheorem for ac circuit.

10.16 POST LAB VIVAQUESTIONS:

1. What are conditions for maximum power transfertheorem?
2. Is it possible to apply maximum power transfertheorem to nonlinearcircuit?

EXPERIMENT - 11

(A)VERIFICATION OF THEVENIN'S THEOREM

11.1 AIM:

To Verify Thevinin'stheorem foran electricalcircuit theoretically and practically.

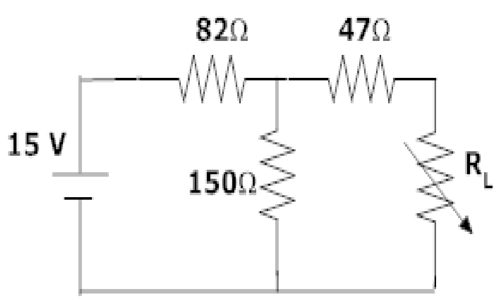
11.2 APPARATUS:

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

11.3 STATEMENT:

Any linear, bilateral network having a number ofvoltage, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance, where the value of the voltage source is equal to the open circuit voltage and the resistance is the equivalent resistance measured between the open circuit terminals with all energy sources replaced by their ideal internal resistances

11.4 CIRCUIT DIAGRAM:



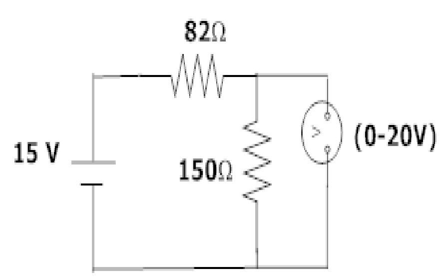


Fig-11.1 Basic CircuitFig-11.2 Measurement of V_{TH} or V_{OC}

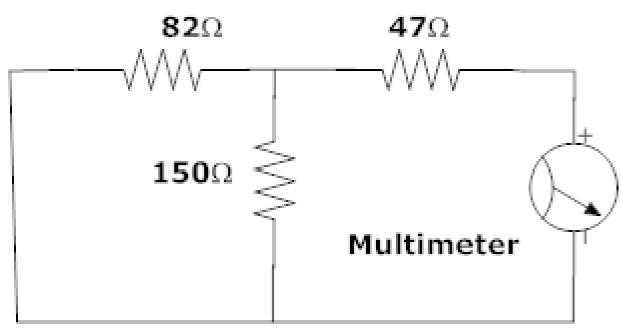


Fig – 11.3 Measurement of R_T

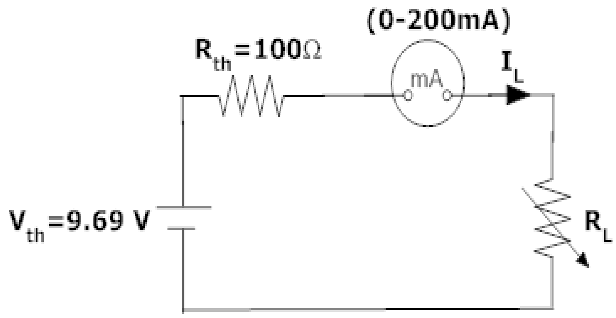


Fig – 11.4Measurement of I_L (I_L=V_{TH} or V_{OC}/ R_{TH}+R_L)

11.5 PROCEDURE:

1. Connect the circuit as shown in fig 11.1
2. Measure current in R_L
3. Connect the circuit as shown in fig11.2.
4. Measure open circuit voltage Voc by open circuiting terminals i.e, V_{TH}
5. Draw the Thevenin's equivalent circuit as shown in fig11.3
6. Measurement current in R_L

11.6 TABULARCOLUMN:

Parameters	Theoretical Values	Practical Values
V_{oc}		
R_{TH}		
I_L		

11.7 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

11.8 RESULT:

(B)VERIFICATION OF THEVENIN'S THEOREM USING DIGITAL SIMULATION

11.9 AIM:

To verifyThevenin's theorem for an electrical circuit using digital simulation.

11.10 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

11.11 CIRCUIT DIAGRAMS:

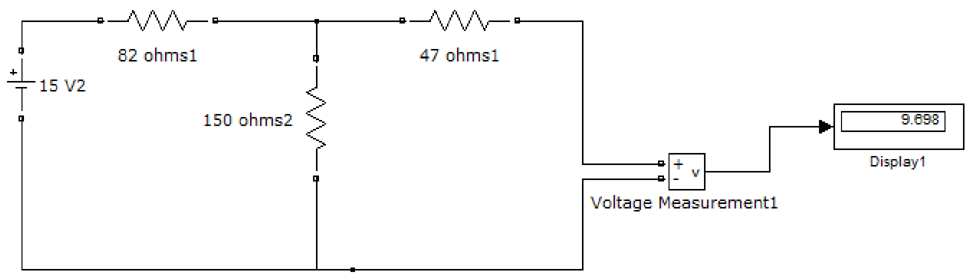


Fig – 11.4 Measurement of V_{TH} or V_{OC}

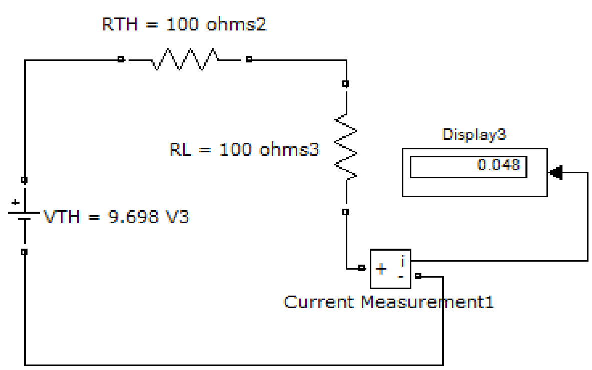


Fig – 11.5 Measurement of I_L ($I_L = V_{TH}$ or $V_{OC}/ R_{TH}+R_L$)

11.12 PROCEDURE:

1. Make the connections as shown in the fig. 11.4 by using MATLAB Simulink.
2. Measure the open circuit voltage across the load terminals using voltage measurement.
3. Connect circuit as shown in fig 11.5 Thevenin's equivalent circuit in MATLAB and find the load current.

11.13 RESULT:

11.14 PRE LAB VIVA QUESTIONS:

1. What is load resistance?
2. Define Thevenin's resistance R_{TH} ?
3. What isThevenin'svoltage$V_{TH?}$
4. How will you calculate load currentI_L?

11.15 LAB ASSIGNMENT:

1. Solve the theoretical value of Thevenin'svoltage for different circuits
2. Solve the theoretical value of Thevenin's resistance for different circuits

11.16 POST LAB VIVA QUESTIONS:

1. Is Thevenin's theorem is applicable to both AC and DC supply?
2. State Thevenin'stheorem.

EXPERIMENT - 12

(A)VERIFICATION OF NORTON 'S THEOREM

12.1 AIM:

To VerifyNorton's theorem for electrical circuit theoretically and practically

12.2 STATEMENT

Any linear, bilateral network with current sources, voltage sources and resistances can be replaced by an equivalent circuit consisting of a current source in parallel with a resistance. The value of the current source is the current flowing through the short circuit terminals of the network and the resistance is the equivalent resistance measured between the open circuit terminals of the network with all the energy sources replaced by their internal resistances.

12.3 CIRCUITDIAGRAM:

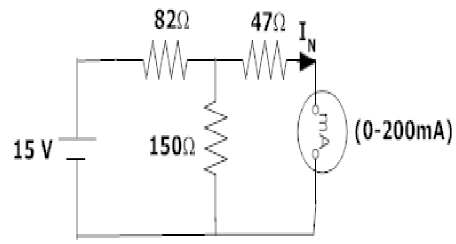
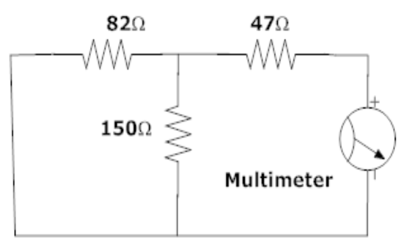
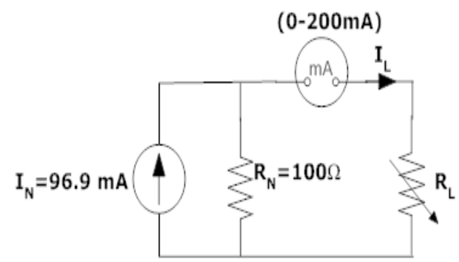


Fig –12.1 Basic Circuit



12.2 Norton's Equivalent Circuit



12.3Norton'sEquivalent Resistance

12.4 PROCEDURE:

1. Connect the circuit diagram as shown infig12.1.
2. Measure the current I_{SC}(or) $I_N$through short circuited terminal.
3. Connect the circuit diagram as shown infig12.2.
4. Find the resistance between open circuited terminals by using multimeter.
5. Draw Norton's equivalent circuit by connecting I_N& $R_N$in parallel as shown infig12.3 and find load current.

12.5 TABULARCOLUMN:

Parameters	Theoretical Values	Practical Values
I_{SC}/ I_N		
R_N		
I_L		

12.6 RESULT:

(B)VERIFICATION OF NORTON'S THEOREM USING DIGITAL SIMULATION

12.7 AIM:

To verify Norton's theorem for an electrical circuit using digital simulation.

12.8 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

12.9 CIRCUIT DIAGRAMS:

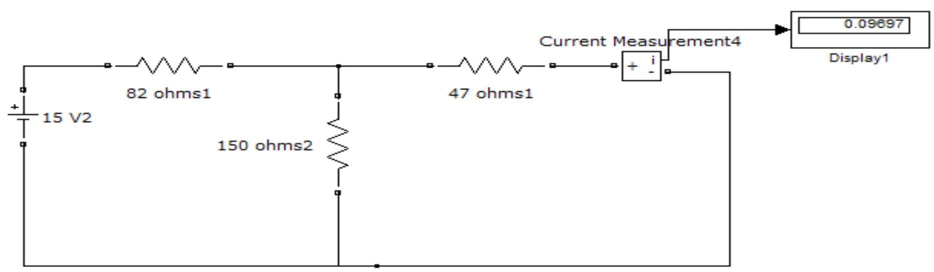


Fig-12.4 Norton'scurrent in MATLAB

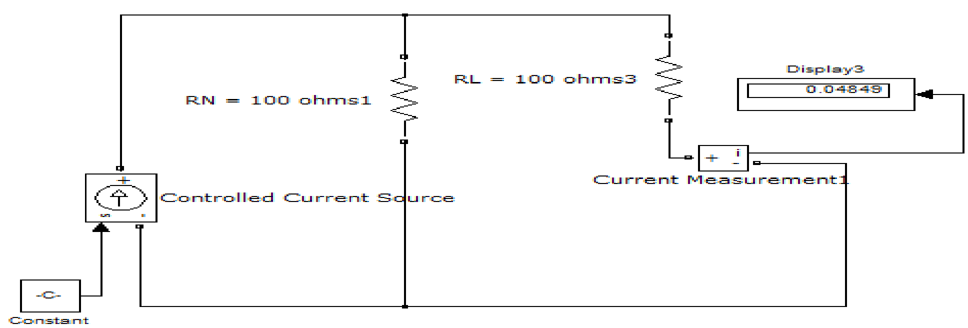


Fig-12.5 Load current in MATLAB

12.9 PROCEDURE:

1. Make the connections as shown in the fig 12.4 by using MATLAB Simulink.
2. Measure the short circuit current through the load terminals using current measurement.
3. Connect the circuit as shown in fig 12.5 using MATLAB and find the load current.

12.10 RESULT:

12.11 PRE LAB VIVAQUESTIONS:

1. State Norton'stheorem.
2. DefineNorton's resistance R_N.
3. Explain the procedure for finding the Norton's current I_N.

12.12 LABASSIGNMENT:

1. State and prove Norton's theorem.
2. Derive the value ofR_N.
3. Find Norton's equivalent resistance from the circuit having dependentsource?

12.13 POST LAB VIVAQUESTIONS:

1. Convert Thevenin's equivalent into Norton'sequivalent.
2. Is it possible to apply Norton's theorem ac as well as dccircuit?
3. What are the applications of Norton'stheorem?

EXPERIMENT – 13

(A)VERIFICATION OF COMPENSATIONTHEOREM

13.1 AIM:

To verify thecompensation theorem and to determine the change in current for an electrical circuit theoretically and practically.

13.2 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Ammeter			
2	Voltmeter			
3	R.P.S			
4	Resistors			
5	Bread Board			
6	Connecting Wires			

13.3 STATEMENT

Compensation theorem states that any element in electrical network can be replaced by its equivalent voltage source, whose value is equal to product of current flowing through it and its value. (Compensation theorem got the importance of determining the change in current flowing through element or circuit because of change in the resistancevalue).

13.4 CIRCUITDIAGRAM:

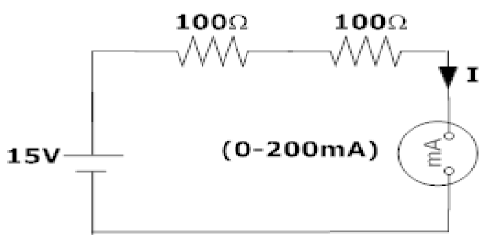


Fig – 13.1Basic Circuit

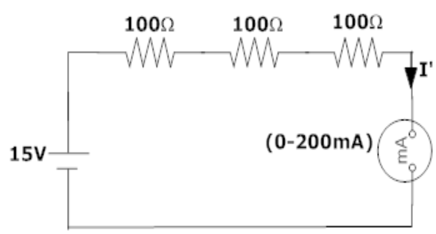


Fig – 13.2addition of resistance(ΔR)=100Ω to find current I′

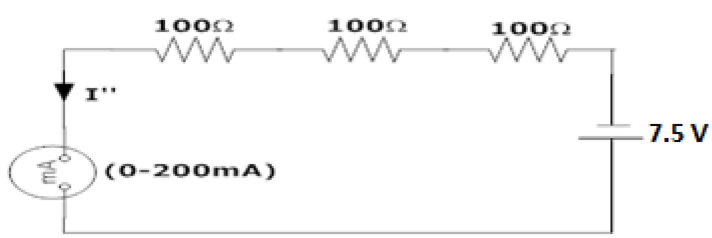


Fig -13.3Compensation Theorem Circuit

13.5 PROCEDURE:

1. Connect the circuit as shown infig13.1.
2. Measure the currentI.
3. Connect the circuit as shown in fig13.2 by increasing the circuit resistance(ΔR=100Ω) Measure the current I′.
4. The change in current in the circuit can be found by connecting a voltage source equal to I′ΔR as shown infig13.3.
5. Measure the current I" i.e., the change incurrent.
6. Observe that I"=I-I′.

13.5 TABULARCOLUMN:

S.No.	Parameters	Theoretical value	Practical value
1			
2			
3			

13.6 RESULT:

(B)VERIFICATION OF COMPENSATION THEOREM USING DIGITAL SIMULATION

13.7 AIM:

To verify compensation theoremfor an electrical circuit using digital simulation.

13.8 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

13.9 CIRCUIT DIAGRAMS:

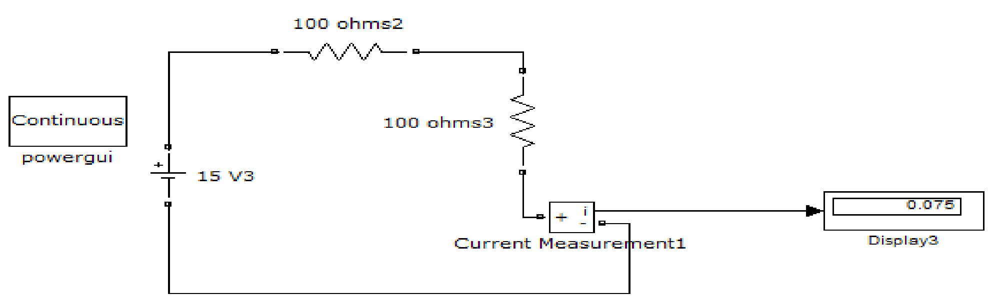


Fig -13.4 Basic circuit in MATLAB

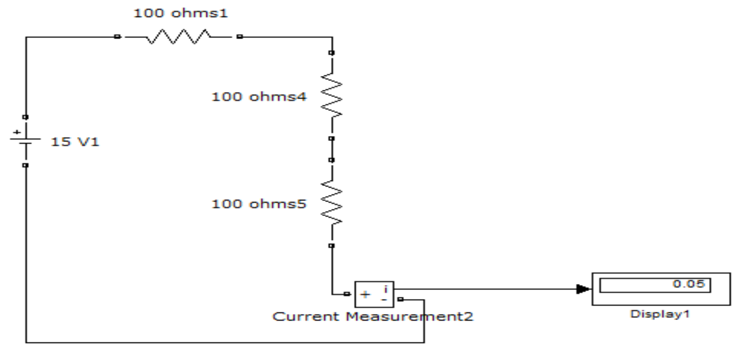


Fig -13.5Simulation with addition of resistance(ΔR)=100Ω to find current I′ in MATLAB

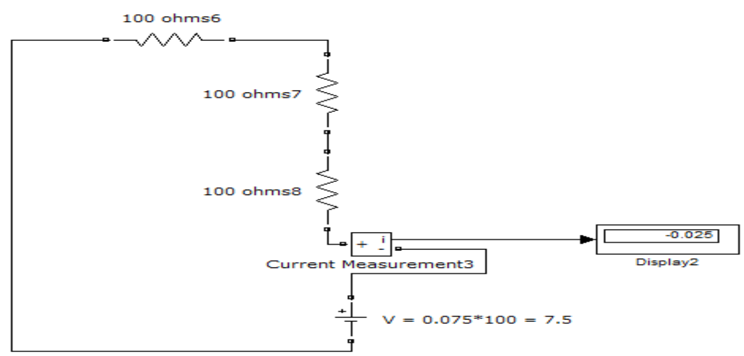


Fig -13.6Compensated Circuit with voltage source(IΔR)in MATLAB

13.10 PROCEDURE:

1. Make the connections as shown in the circuit diagram13.4 by using MATLAB Simulink.
2. Using fig.13.4 find the current flowing through original circuit.
3. Using fig 13.5 find current flowing through the change in resistance circuit.
4. From fig13.6 find the changed current.

13.11 RESULT:

13.12 PRE LAB VIVAQUESTIONS:

1. What is Compensationtheorem?
2. Is it possible to apply compensation theorem to ac as well as dccircuit?
3. Is Compensationtheorem applicable for unilateral and bilateralnetworks?

13.13 LABASSIGNMENT:

1. State and prove Compensationtheorem.
2. Give the importance of Compensationtheorem.

13.14 POST LAB VIVAQUESTIONS:

1. Which condition is required to apply the Compensation theorem for thecircuit?
2. Is compensation theorem is applicable to linear and non-linear circuits?

EXPERIMENT – 14

A) VERIFICATION OF MILLIMAN'STHEOREM

14.1 AIM:

To verify the Milliman's Theorem for an electrical circuit theoretically and practically.

14.2 STATEMENT:

This theorem states that in any network, if the voltage sources V1,V2,…….Vn in series with their internal resistances R_1,R_2…. Rn respectively are in parallel, then these sources may be replaced by a single voltage source V' in series-with R'.

$$V' = \frac{V_1G_1+V_2G_2+V_3G_3+\cdots+V_nG_n}{G_1+G_2+G_3+\cdots+G_n} \quad \text{..................................(1)}$$

$$R' = \frac{1}{G_1+G_2+G_3+\cdots+G_n} \quad \text{..(2)}$$

14.3 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Ammeter			
2	Voltmeter			
3	R.P.S			
4	Resistors			
5	Bread Board			
6	Connecting Wires			

14.4 CIRCUITDIAGRAM:

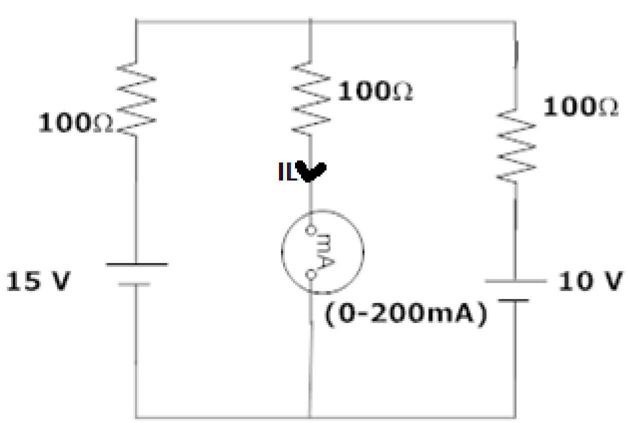
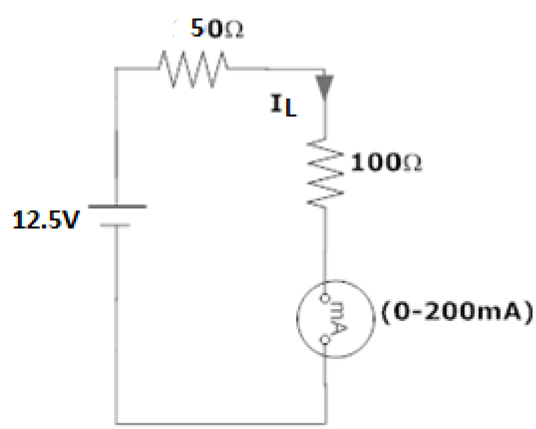


Fig – 14.1 BasicCircuit



Fig– 14.2 Millman'sCircuit

14.5 PROCEDURE:

1. Connect the circuit as shown infig.14.1
2. Measure the current through the resistor100Ω.
3. Connect the circuit as shown in fig.14.2 and measure the current through100Ω.
4. Observe whether the two currents areequal.

14.6 TABULARCOLUMN:

S.No.	Parameters	Theoretical value	Practical value
1			
2			

14.7 RESULT:

(B)VERIFICATION OF MILLIMAN'S THEOREM USING DIGITAL SIMULATION

14.8 AIM:

To verify Milliman'stheorem for an electrical circuit using digital simulation.

14.9 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

14.10 CIRCUIT DIAGRAMS:

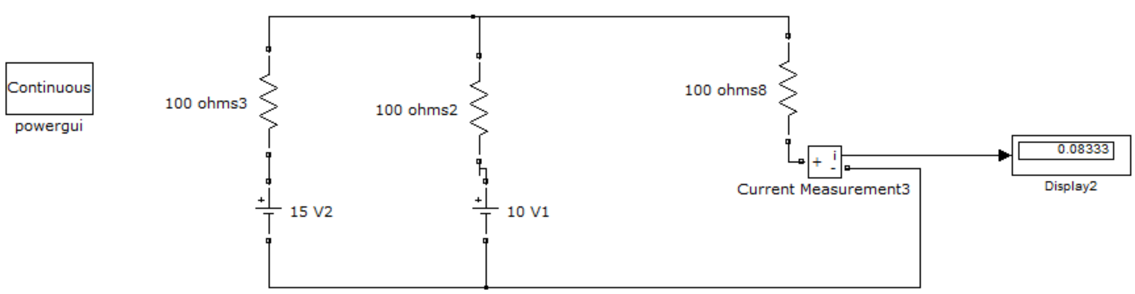


Fig – 14.3 Simulation BasicCircuit

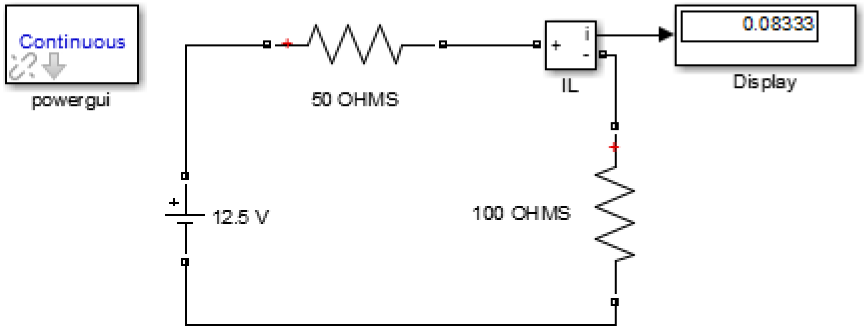


Fig – 14.4 Simulation circuit-Load current(I_L)

14.11 PROCEDURE:

1. Connect the circuit as shown infig 14.3 using MAT LAB Simulink.
2. Measure the current through the 100 Ω resistor.
3. Connect the circuit as shown in fig.11.4 and measure the current through100 Ω.
4. Observe whether the two currents areequal.

14.12 RESULT:

14.13 PRE LAB VIVAQUESTIONS:.

1. State Milliman'stheorem.
2. Is it possible to apply Milliman's theorems to ac as well as dccircuit?
3. Is Milliman's theorem is applicable for unilateral and bilateralnetworks?

14.14 LABASSIGNMENT:

1. State and prove Milliman'stheorem.
2. State application of Milliman'stheorem.

14.15 POST LAB VIVAQUESTIONS:

1. Which condition is required to apply the Millman's theorem for thecircuit?
2. Is Milliman's theorem is applicable for linear and non-linear networks?