FUNDAMENTALS OF ELECTRICAL ENGINEERING LABORATORY

LAB MANUAL

Subject Code	**:**	**AEEB05**
Regulation	**:**	**IARE - R18**
Class	**:**	**I Year I Semester**
Branch	**:**	**CSE/IT**
Year	**:**	**2019-20**

Department of Electrical and Electronics Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal – 500 043, Hyderabad

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

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, Kirchhoff's current and voltage laws using hardware and digital simulation.	PO1,PO5	PSO2
2	Determination of unknown resistance and its temperature dependency.	PO1,PO2,PO5	PSO2
3	Determination of mesh currents using hardware and digital simulation.	PO1,PO2,PO5	PSO2
4	Measurement of nodal voltages using hardware and digital simulation.	PO4,PO5	PSO2
5	Calculation of average value, RMS value, form factor, peak factor of sinusoidal wave using hardware	PO1,PO2, PO5	PSO2
6	Examine the impedance of series RL Circuit	PO1,PO2, PO5	PSO2
7	Measure the impedance of series RC Circuit	PO1,PO2, PO5	PSO2
8	Calculate the impedance of series RLC Circuit	PO1,PO2,PO5	PSO2
9	Obtain power consumed and power factor of a fluorescent lamp, operated at different voltages.	PO1,PO2,PO5	PSO2
10	Determination of internal resistance and inductance of choke coil.	PO2,PO3,PO5	PSO2
11	Verification of Thevenin's theorem using hard ware.	PO2,PO3,PO5	PSO2
12	Verification of Norton's theorem using hard ware.	PO2,PO3,PO5	PSO2

FUNDUMENTALS OF ELECTRICAL ENGINEERING LABORATORY

OBJECTIVE:

The course should enable the students to:

I. Examine the basic laws and network reduction techniques.
II. Predict the characteristics of sinusoidal function
III. Measure impedance of series RL, RC and RLC circuits.
IV. Prove the various theorems used to reduce the complexity of electrical network

OUTCOMES:

Upon the completion of Fundamentals of Electrical Engineering 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 Measure impedance of series RL, RC and RLC circuits.

EXPERIMENT – 1

A) VERIFICATION OF OHM'S LAW

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

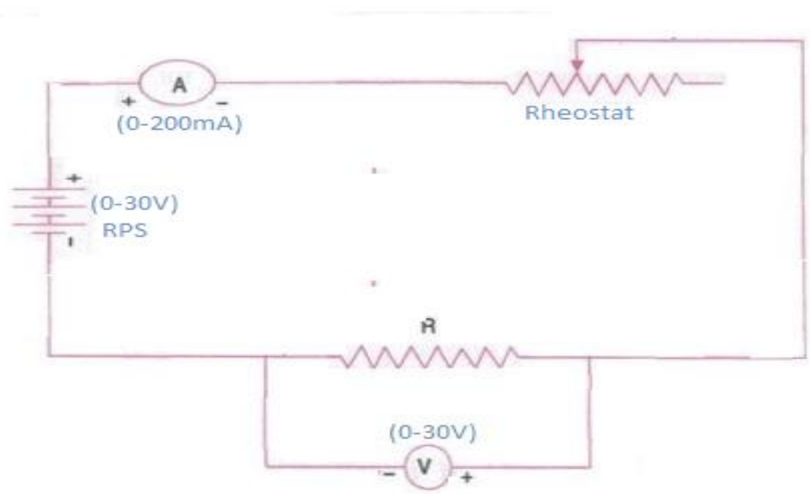

Figure – 1.1 Verification of Ohm's Law

1.4 PROCEDURE

1. Make the connections as per circuit diagram.
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

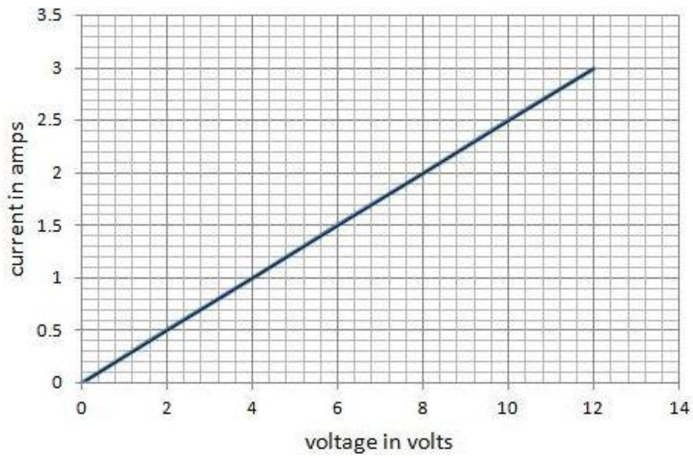

Figure – 1.2 Verification of Ohm's Law Graph

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.

1.8 RESULT

B) VERIFICATION OF OHM'S LAW USING DIGITAL SIMULATION

1.9 AIM:

To verify Ohm's law for a given resistive network using digital simulation.

1.10 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

1.11 CIRCUIT DIAGRAMS:

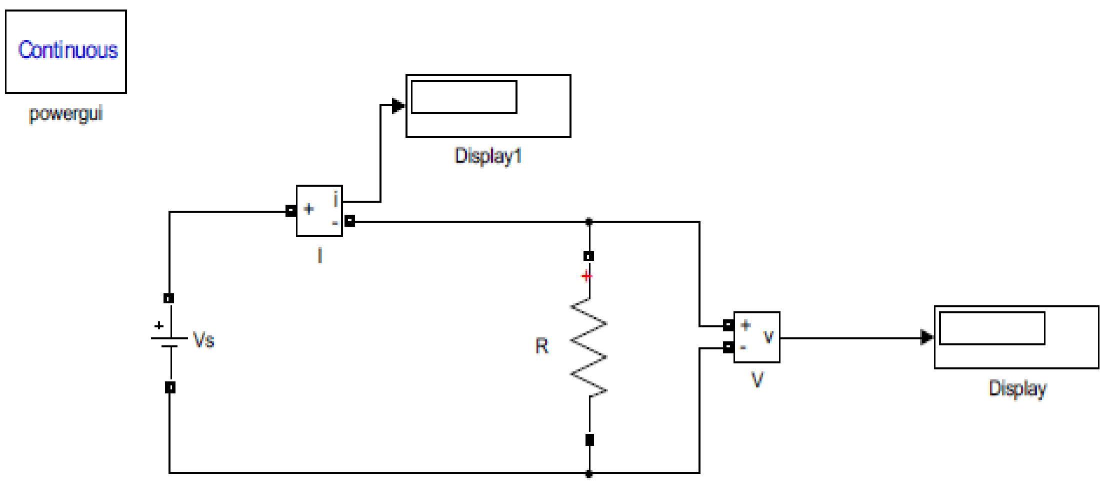

Figure – 1.3 Verification of Ohm's Law

1.12 PROCEDURE

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure the voltages and currents in resistor.
3. Verify the OHM'S law

1.13 OBSERVATIONS

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

1.14 MODEL GRAPH

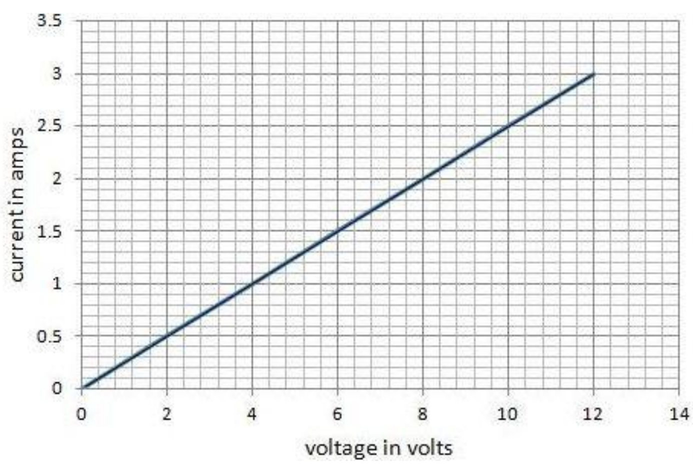

Figure – 1.4 Verification of Ohm's Law Graph

1.15 RESULT

1.16 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?

1.17 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?

C) VERIFICATION OF KVL AND KCL

1.18 AIM:

To verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) in a passive resistive network.

1.19 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.

$$\sum_k I_k = 0$$

1.20 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

1.21 CIRCUIT DIAGRAMS:

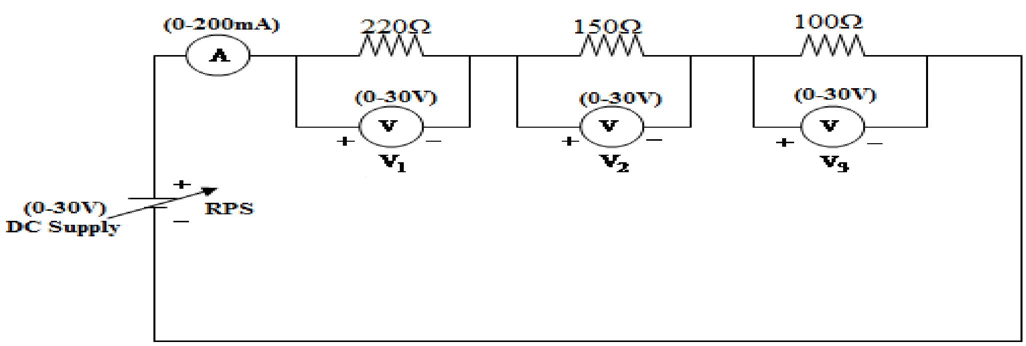

Figure – 1.5 Verification of KVL

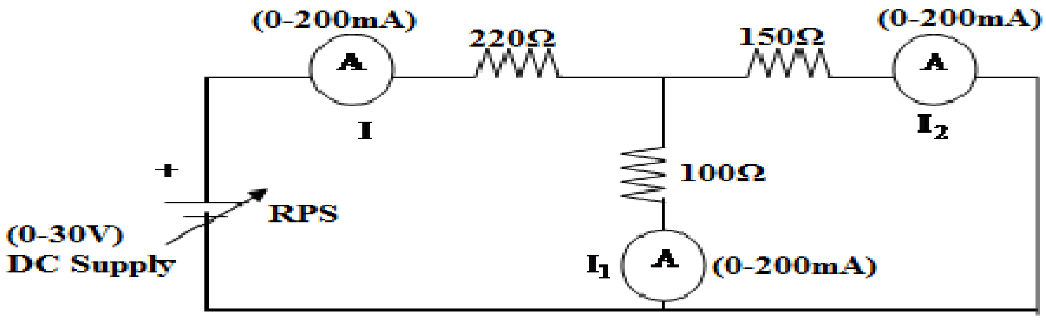

Figure – 1.6 Verification of KCL

1.22 PROCEDURE:

To Verify KVL

1. Connect the circuit diagram as shown in Figure
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. 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

1.23 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

1.24 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.

1.25 RESULT:

(C) VERIFICATION OF KVL AND KCL USING DIGITAL SIMULATION

1.26 AIM:

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

1.27 APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

1.28 CIRCUIT DIAGRAMS:

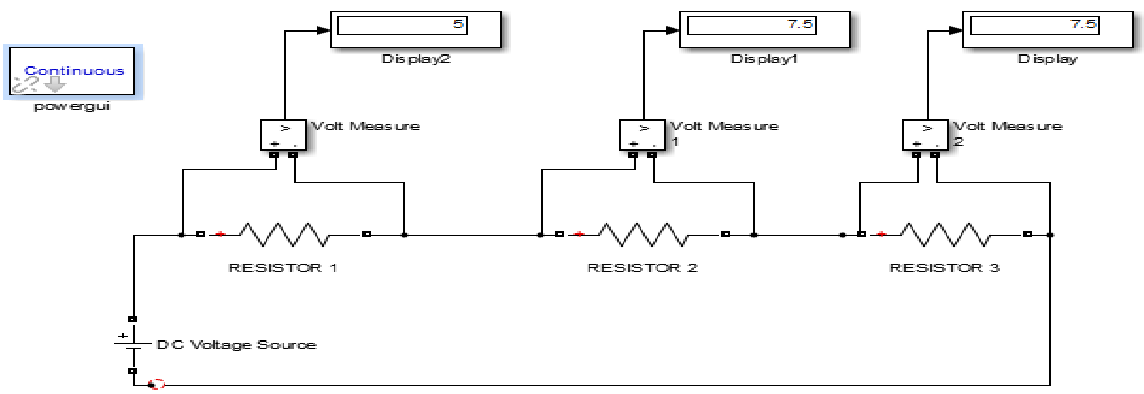

Figure – 1.7 Verification of KVL

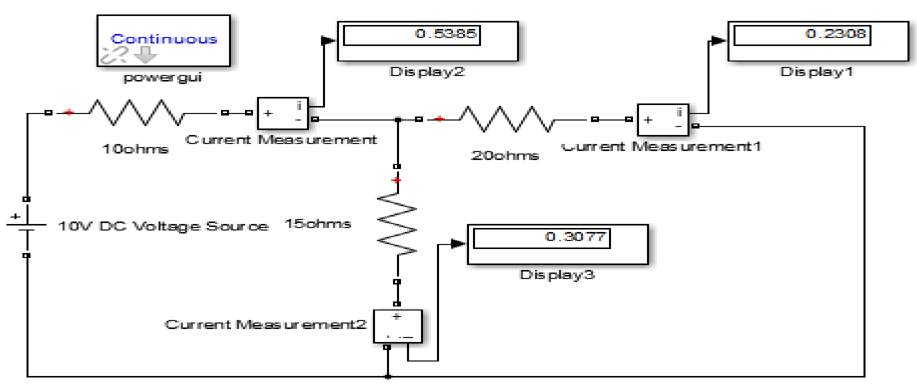

Figure – 1.8 Verification of KCL

1.29 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.

1.30 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

1.31 RESULT:

1.32 PRE LAB VIVA QUESTIONS:

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

1.33 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

VOLT – AMPHERE METHOD

2.1 AIM:

To measure of resistor by the voltmeter and ammeter method.

2.2 APPARATUS:

S.No	Apparatus Name	Type	Range
1	DC Power Supply	-	(0-30) V
2	Variable Resistance	-	100 Ω
3	Ammeter	DC	(0-500) mA
4	Voltmeter	DC	(0-5) V
5	Connecting wires.	-	

2.3 THEORY:

Two types of the connections are done one employed for the ammeter voltmeter method as shown in the figure voltmeter and ammeter are connected in series, where ammeter measures the total current flowing through the circuit and voltmeter measures the voltage across the unknown resistance .The voltmeter should have ideally infinite resistance and ammeter should have ideally zero resistance so that it will measure total current flowing through the unknown resistance. But practically it is not possible and measured value Rm of the resistance is the sum of resistance of ammeter and actual resistance.

$Rm=R1+Ra$ Where
R1=Actual resistance. Ra=resistance of the ammeter.

It is clear from the expression that the value of measured resistance is equal to actual resistance when ammeter has zero resistance.

2.4 CIRCUIT DIAGRAM:

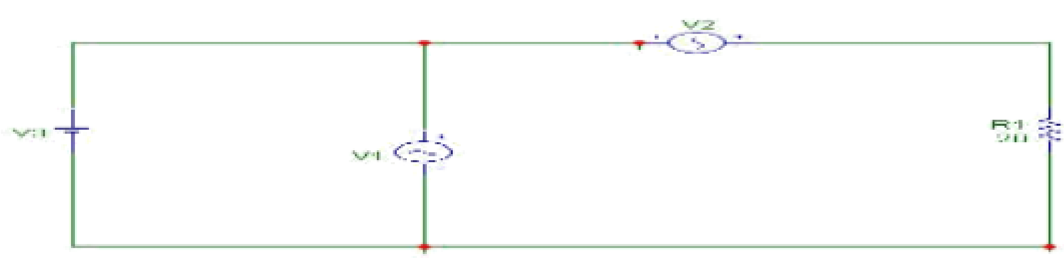

Figure: 2.1 Circuit for Volt- Amphere method

2.5 PROCEDURE:

1. Make the connections as per circuit diagram.
2. Switch on the supply and note down the readings of ammeter and voltmeter.
3. Calculate the value of the unknown resistance by ohms low.
4. Perform the procedure for the other case similarly.

2.6 TABULAR COLUMN:

Voltage (Volts)	Current (Amps)	Resistance (Calculated)	Resistance (Measured)

2.7 RESULT:

2.8 PRELAB VIVA QUESTIONS:

1. What does a voltmeter tell you?
2. How do you connect a voltmeter?
3. What does ammeter tell you?
4. How do you connect ammeter?

2.9 POSTLAB VIVA QUESTIONS

1. What happens when voltmeter is connected in series?
2. What is the difference between volt and amp?
3. How many amps are in a Volt?
4. Do volts or amps kill?

EXPERIMENT - 3

(A) MESH ANALYSIS

3.1 AIM

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

3.2 APPARATUS:

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

3.3 THEORY:

Multi-source DC circuits may be analyzed using a mesh current technique. The process involves identifying 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.

3.4 CIRCUIT DIAGRAM:

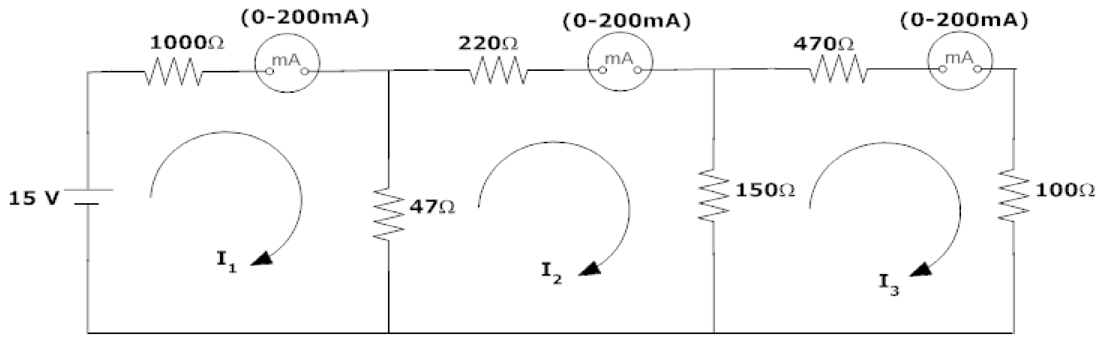

Figure – 3.1 Mesh analyses

3.5 PROCEDURE

1. Connect the circuit diagram as shown in Figure.
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

3.6 OBSERVATIONS:

Applied Voltage V (volts)	Loop current(I_1)		Loop current (I_2)		Loop current(I_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:

(A) MESH ANALYSIS USING DIGITAL SIMULATION

3.9 AIM:

To verify mesh analysis for an electrical circuit using digital simulation.

3.10 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	01

3.11 SIMULATION DIAGRAMS:

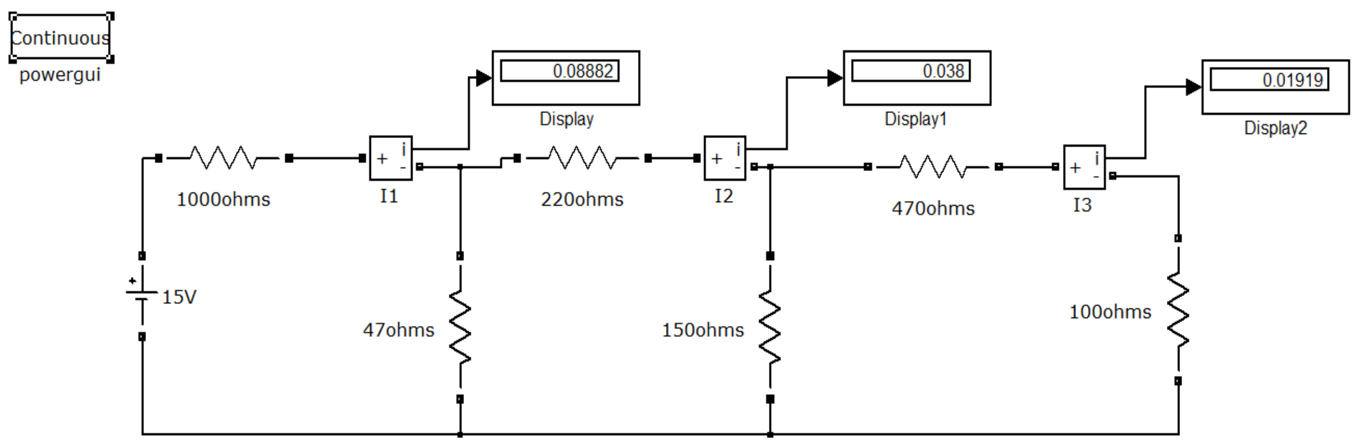

Figure – 3.2 Mesh analysis in MATLAB

3.12 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.

3.13 OBSERVATIONS:

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

3.14 RESULT

3.15 PRE LAB VIVA 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?

3.16 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 - 4
(A) NODAL ANALYSIS

4.1 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.

4.2 APPARATUS:

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

4.3 THEORY:

In electric circuit 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.

4.4 CIRCUIT DIAGRAM:

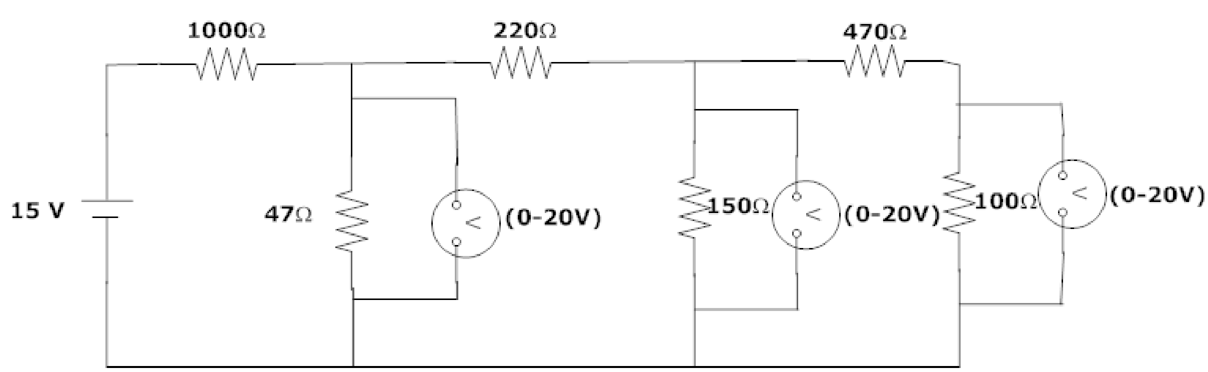

Figure – 4.1 Nodal analyses

4.5 PROCEDURE

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

4.6 OBSERVATIONS:

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

4.7 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.

4.8 RESULT

(B) NODAL ANALYSIS USING DIGITAL SIMULATION

4.9 AIM:

To verify nodal analysis for an electrical circuit using digital simulation.

4.10 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	01

4.11 SIMULATION DIAGRAMS:

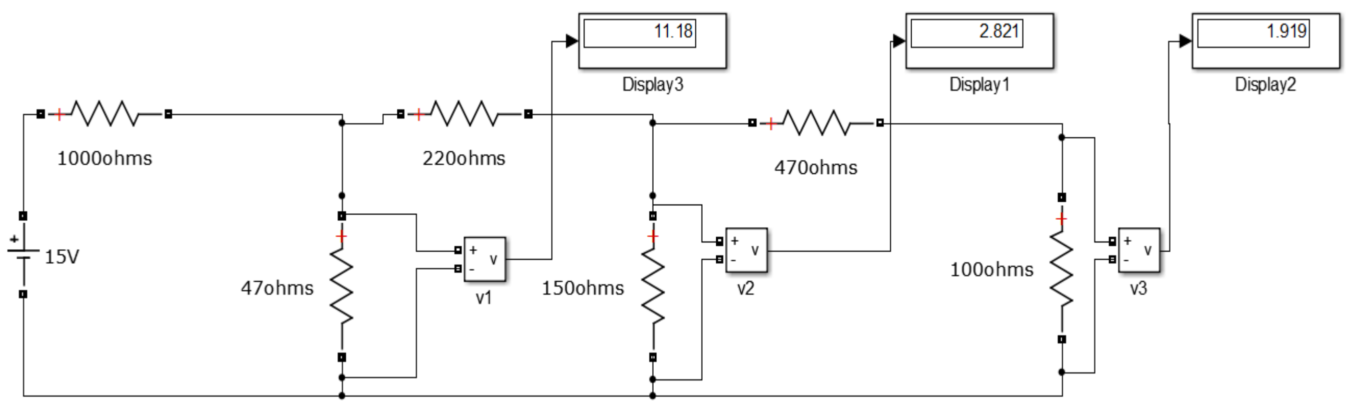

Figure – 4.2 Nodal analysis in MATLAB

4.12 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 the theoretical node voltages obtained with practical values.

4.13 OBSERVATIONS:

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

4.14 RESULT:

4.15 PRE LAB VIVA 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?

4.16 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 - 5
SINGLE PHASE AC CIRCUITS

5.1 AIM:

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

5.2 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

5.3 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 (*ω* = 2π/*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.

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

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.

5.4 CIRCUIT DIAGRAM:

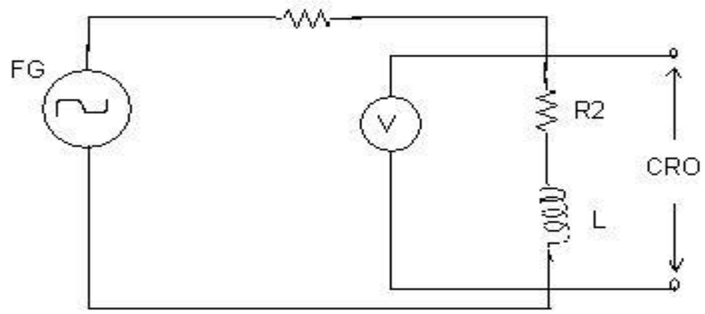

Fig – 5.1 Basic Circuit

5.5 PROCEDURE:

1. Connect the circuit as shown in the circuit diagram of figure.
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.

5.6 OBSERVATIONS & CALCULATIONS:

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

5.7 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

5.8 RESULT:

5.9 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?

5.10 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 - 6

IMPEDANCE OF SERIES RL CIRCUIT

6.1 AIM:

Examine the impedance of series RL Circuit.

6.2 APPARATUS:

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

6.3 CIRCUIT DIAGRAM:

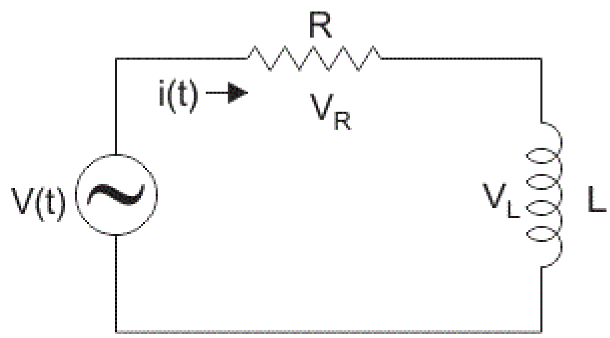

Figure 6.1 RL Circuit

6.4 PROCEDURE:

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

6.5 TABULAR COLUMN:

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

6.6 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

6.7 RESULT

6.8 PRE LAB VIVA QUESTIONS:

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

6.9 POST LAB VIVA QUESTIONS:

1. Inductor does not allow sudden change of current, why?
2. Write the expression for voltage across inductor and energy stored in inductor?

EXPERIMENT - 7

IMPEDANCE OF SERIES RC CIRCUIT

7.1 AIM:

Examine the impedance of series RC Circuit.

7.2 APPARATUS:

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

7.3 CIRCUIT DIAGRAM:

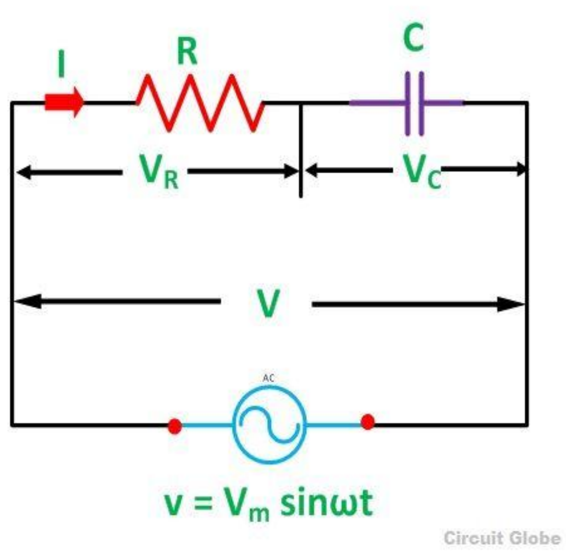

Figure 7.1 RC Circuit

7.4 PROCEDURE:

1. Connect the circuit as shown in the circuit diagram of figure.
2. Check for proper connections before switching ON the supply
3. Using figure with E, R and C, Measure the current and voltage flowing throw resistors and capacitor.
4. Calculate the impedance value of RC circuit theoretically and practically

7.5 TABULAR COLUMN:

V_R(VOLTS)	V_C (VOLTS)	I(AMPS)	IMPEDANCE

7.6 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

7.7 RESULT:

7.8 PRE LAB VIVA QUESTIONS:

1. Define capacitor.
2. Define resistor?
3. Write applications of series RC circuits.

7.9 POST LAB VIVA QUESTIONS:

1. Capacitor does not allow sudden change of voltage, why?
2. Write the expression for voltage across capacitor and energy stored in capacitor?

EXPERIMENT - 8

IMPEDANCE OF SERIES RLC CIRCUIT

8.1 AIM:

Examine the impedance of series RLC Circuit.

8.2 APPARATUS:

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

8.3 CIRCUIT DIAGRAM

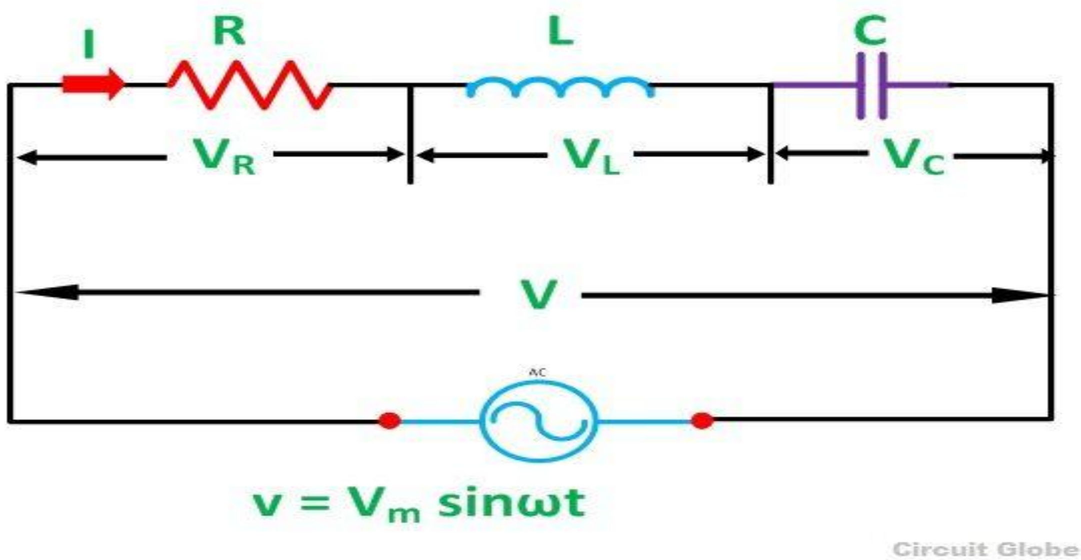

Figure 8.1 RLC Circuit

8.4 PROCEDURE:

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

8.5 TABULAR COLUMN:

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

8.6 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, inductor and inductor should be properly connected

8.7 RESULT:

8.8 PRE LAB VIVA QUESTIONS:

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

8.9 POST LAB VIVA QUESTIONS:

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

EXPERIMENT – 9

MEASURMENT OF POWER CONSUMED BY A FLUORESCENT LAMP

9.1 AIM:

To obtain power consumed and power factor of a fluorescent lamp, operated at different voltages.

9.2 APPARATUS:

S.No	Apparatus Name	Type	Range
1	Fluorescent Lamp	-	
2	Choke	-	
3	Starter	-	
4	Ammeter	MI	(0-10) A
5	Voltmeter	MI	(0-300) V
6	Wattmeter	UPF	600 V, 10 A
7	Variac	-	(230/0-270) V, 10A

9.3 THEORY:

A fluorescent lamp is a low pressure mercury discharge lamp with internal surface coated with suitable fluorescent material. This lamp consists of a glass tube provided at both ends with caps having two pins and oxide coated tungsten filament. Tube contains argon and krypton gas to facilitate starting with small quantity mercury under low pressure. Fluorescent material, when subjected to electro-magnetic radiation of particular wavelength produced by the discharge through mercury vapors, gets excited and in turn gives out radiations at some other wavelength which fall under visible spectrum. Thus the secondary radiations from fluorescent powder increase the efficiency of the lamp. Power Factor (P.F.) of the lamp is somewhat low is about 0.5 lagging due to the inclusion of the choke. A condenser, if connected across the supply may improve the P.F. to about 0.95 lagging. The light output is a function of its supply voltage. At reduced supply voltage, the lamp may click a start but may fail to hold because of non-availability of reduced holding voltage across the tube. Higher normal voltage reduces the useful life of the tube light to very great extent. If applied voltage of a fluorescent lamp is V, line current is I and input power is $P = VI\cos\phi$ where $\cos\phi = \left(P/_{VI}\right)$ power factor of fluorescent lamp.

9.4 CIRCUIT DIAGRAM:

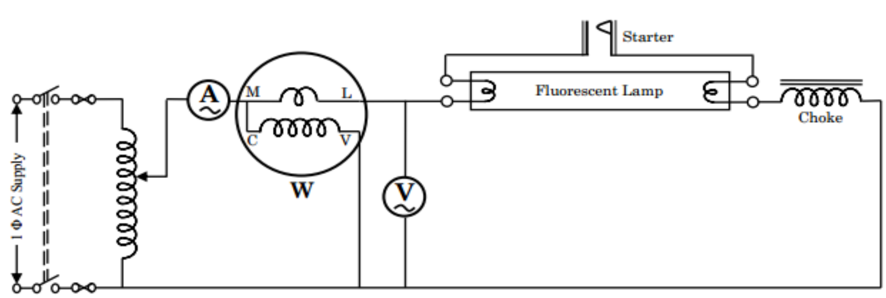

Figure: 9.1 Circuit formeasurement of power consumed by a fluorescent lamp

9.5 PROCEDURE:

1. Connect the circuit as shown in Figure.
2. Keep the variac in minimum or zero position.
3. Switch ON the ac supply and increase gradually till the lamp strikes.
4. Note down the reading of striking voltage.
5. Increase the applied voltage to the rated value step by step and note down the applied voltage, line current and power input to the lamp.
6. Now decrease applied voltage step by step till lamp extinguishes and note down applied voltage, line current and power input to lamp in each step. Note down the extinguishing voltage.
7. Switch OFF the power supply and disconnect the circuit from the supply.

9.6 TABULAR COLUMN:

S.No	Applied voltage increasing		
	Striking voltage (volts)		
	Applied Voltage	**Line Current**	**Power Input**
1			
2			
3			

9.7 RESULT:

9.8 PRELAB VIVA QUESTIONS:

5. What is a florescent lamp?
6. Explain the working of florescent lamp?
7. What is the composition of inert gases used in filament lamp?
8. Why filament is in coil shape?

9.9 POSTLAB VIVA QUESTIONS

1. What is the power factor of a lamp?
2. What is the function of starter? What is the function of choke?
3. Can we use fluorescent lamp in DC?
4. Filament of lamp is made by….?

EXPERIMENT - 10

CHOKE COIL PARAMETERS

10.1 AIM:

To determine internal resistance and inductance of choke coil.

10.2 APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1.	Choke Coil			
2.	1 –phase Variac			
3.	Voltmeter			
4.	Ammeter			
5.	Rheostat			
6.	Connecting wires			

10.3 CIRCUIT DIAGRAM:

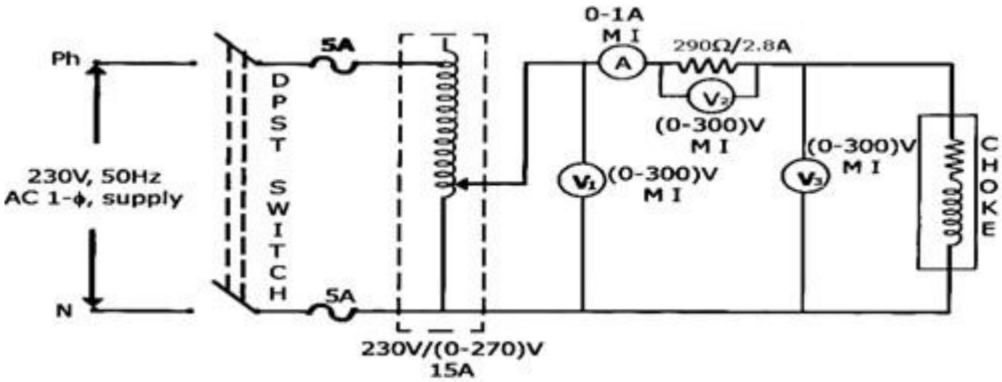

Fig – 10.1 Three Voltmeter Method

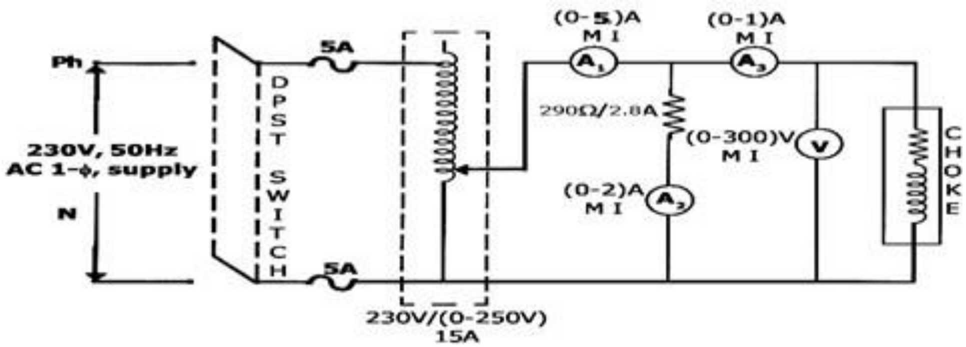

Fig – 10.2 Three Ammeter Method

10.4 PROCEDURE:

Three Voltmeter Method

1. Connect as per circuit diagram.
2. Initially the variac should be minimum output position and adjusted the rheostat at 100ohm.
3. By slowly varying the Auto Transformer the Voltmeter V_3 is adjusted to rated voltage of choke.
4. Note down the corresponding readings of V_2 & V_1.

Three Ammeter Method

1. Make the connection as per the circuit diagram.
2. Initially the variac should be minimum output position and adjusted the rheostat at 100ohm.
3. By slowly varying the Auto Transformer the Ammeter A is adjusted till the rated current is reached.
4. Note down the corresponding readings of A_2 & A_1.

10.5 TABULAR COLUM:

Three Voltmeter Method

S. No	Ammeter Reading (A)	Voltmeter Reading (V_1)	Voltmeter Reading (V_2)	Voltmeter Reading (V_3)	Power (W)	Resistance (Ω)	Inductance (mH)
1.							
2.							
3.							
4.							

Three Ammeter Method

S. No	Voltmeter Reading (V)	Ammeter Reading (A_1)	Ammeter Reading (A_2)	Ammeter Reading (A_3)	Power (W)	Resistance (Ω)	Inductance (mH)
1.							
2.							
3.							
4.							

10.6 MODEL CALCULATION:

Three Voltmeter Method

$P = (V_1^2 – V_2^2 – V_3^2)/ 2R$

$Cos Ø = (V_1^2 – V_2^2 – V_3^2) / 2V_2V_3$

$I = V_2/R$

$Z = V_3/I$

$R = Z Cos Ø$

$X_2 = Z Sin Ø$

$L = X_L/2\prod f$

Three Ammeter Method

$P = [(I_1^2 – I_2^2 – I_3^2)/2]^* R$

$Cos Ø = (I_1^2 – I_2^2 – I_3$ 2 3

$^2)/2I$ I $V = I_2R$

$Z = V/I$

$R = Z cos Ø$

$X_L = Z$

sinØ $L = X_L/2\prod f$

10.7 RESULT:

10.8 PRE LAB VIVA QUESTIONS

1. What is meant by choke coil?
2. What is the function of choke coil?
3. What are the different parameters of choke coil?
4. Explain the operation of 3-volt meter method.
5. Explain the operation of 3 ammeter method.
6. What is DPST switch?
7. What is the purpose of using auto transformer?

10.9 POST LAB VIVA QUESTIONS

1. Which method is better to find choke coil parameters? Ammeter method or voltmeter method?
2. What is the disadvantage of resistance of a choke coil?
3. What is ideal choke coil?
4. What is the power factor of choke coil?
5. What are the different applications of choke coil?

EXPERIMENT - 11

VERIFICATION OF THEVENIN'S THEOREM

11.1 AIM:

To Verify Thevinin's theorem for an electrical circuit 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 of voltage, 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:

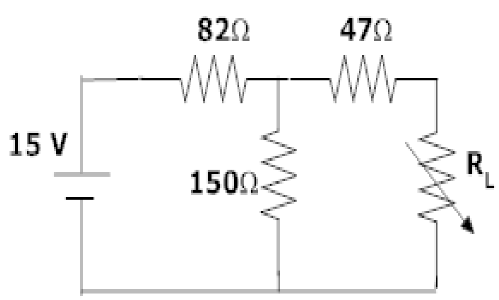

Fig-11.1 Basic Circuit

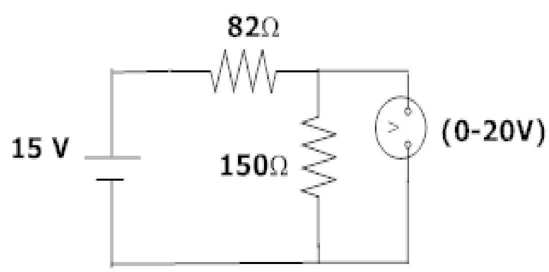

Fig-11.2 Measurement of V_{TH} or V_{OC}

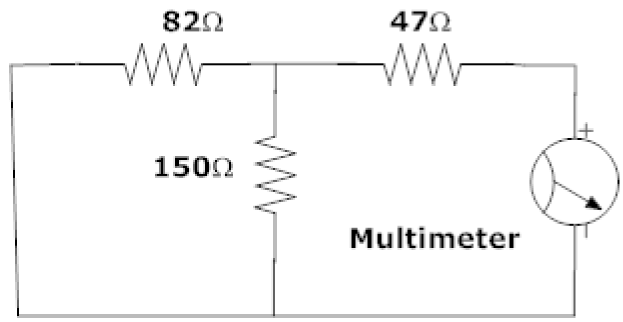

Fig – 11.3 Measurement of R_T

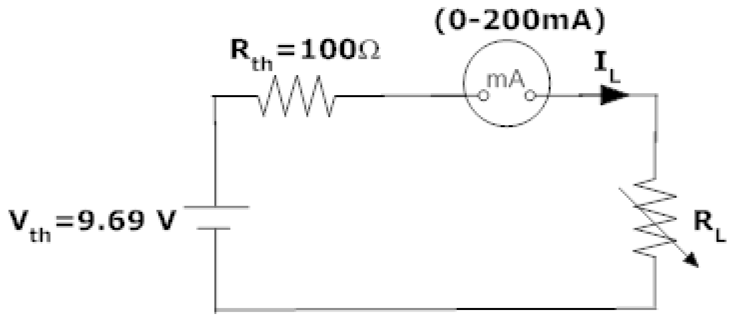

Fig – 11.4 Measurement of I_L (I_L = V_{TH} or V_{OC}/ R_{TH} +R_L)

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 fig 11.2.
4. Measure open circuit voltage Voc by open circuiting terminals i.e, V_{TH}
5. Draw the Thevenin's equivalent circuit as shown in fig 11.3
6. Measurement current in R

11.6 TABULAR COLUMN:

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:

11.9 PRE LAB VIVA QUESTIONS

1. What is load resistance?
2. How will you calculate Thevenin's resistance RTH?
3. How will you calculate Thevenin's voltage VTH?

11.10 POST LAB VIVA QUESTIONS

1. How will you calculate load current IL?
2. Write the applications of Thevenin's theorem.
3. Write the limitations of Thevenin's theorem.

EXPERIMENT - 12

VERIFICATION OF NORTON 'S THEOREM

12.1 AIM:

To Verify Norton'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 CIRCUIT DIAGRAM:

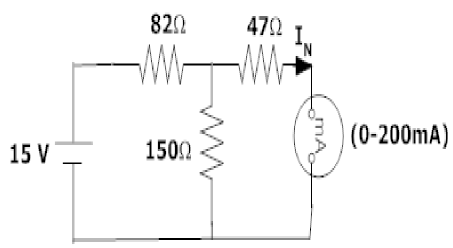

Fig – 12.1 Norton's Current Circuit

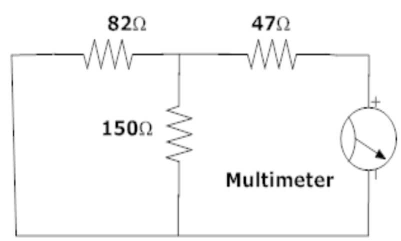

Fig – 12.2 Norton's Equivalent Resistance circuit

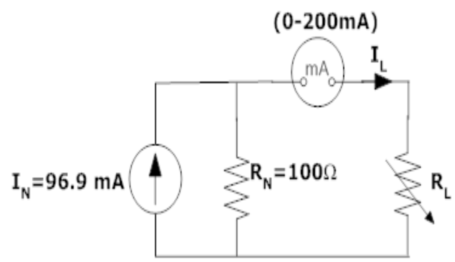

Fig – 12.3 Norton's Equivalent Circuit

12.4 PROCEDURE:

1. Connect the circuit diagram as shown in fig 12.1.
2. Measure the current I_{SC} (or) I_N through short circuited terminal.
3. Connect the circuit diagram as shown in fig 12.2.
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 in fig 12.3 and find load current.

12.5 TABULAR COLUMN:

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

12.6 RESULT:

12.7 PRE LAB VIVA QUESTIONS

1. What is load resistance?
2. How will you calculate Norton's resistance R_N?
3. How will you calculate Norton's current I_N?

12.8 POST LAB VIVA QUESTIONS

1. How will you calculate load current I_L?
2. Write the applications of Norton's theorem.
3. Write the limitations of Norton's theorem.