LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
[AUTONOMOUS]

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

STUDENT MANUAL

BASIC ELECTRICAL ENGINEERING LABORATORY(U23EE2L1)

A.Y:2023-24

NAME OF THE STUDENT : ______________________________

ROLL NUMBER : ______________________________

BRANCH : ______________________________

YEAR & SEMESTER : I-BE-II SEM

REGULATIONS : LR23

LORDS INSTITUTE OF ENGINEERING & TECHNOLOGY [A]

Approved by AICTE / Affiliated to Osmania University / Estd.2003.

Accredited "A" grade by NAAC, Accredited by NBA

BASIC ELECTRICAL ENGINEERING LABORATORY B.E IST YEAR IST SEMESTER

2023-2024

PREFACE

Demonstration - 1: Basic safety precautions. Introduction and use of measuring instruments –voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

Demonstration – 2: Demonstration of cut-out sections of Machines: DC Machine (Commutator- brush arrangement), Transformers, Induction Machine (Squirrel cage rotor), Synchronous Machine (Field winging - slip ring arrangement) and Single-Phase Induction Machine.

GUIDELINES TO WRITE YOUR OBSERVATION BOOK

1. Experiment Title, Aim, Apparatus, Procedure should be on right side.
2. Circuit diagrams, Model graphs, Observations table, Calculations should be on left side.
3. Theoretical and model calculations can be any side as per your convenience.
4. Result should always be in the ending.
5. You all are advised to leave sufficient no of pages between experiments for theoretical or model calculation purpose.

INSTRUCTIONS TO THE STUDENTS TO CONDUCT AN EXPERIMENT:

1. Students are supposed to come to the lab with preparation, proper dress code
2. Dress code: Boys: Shoe & Tuck. Girls: Apron & Cut shoe.
3. Don't switch on the power supply without getting your circuit connections verified
4. Disciplinary action can be taken in the event of mishandling the equipment or switching on the power supply without faculty presence
5. All the apparatus taken should be returned to Lab Assistant concerned, before leaving the lab.
6. You have to get both your Observation book and your Record for a particular experiment corrected well before coming to the next experiment.

LABORATORY PRACTICE SAFETY RULES

SAFETY is of paramount importance in the Electrical Engineering Laboratories.

1. Electricity NEVEREXECUSES careless persons. So, exercise enough care and attention in handling **electrical** equipment and follow **safety** practices in the laboratory. (Electricity is a good servant but a bad master).

2. Avoid direct contact with any voltage source and power line voltages (Otherwise, any such contact may subject you to **electrical** shock)

3. Wear rubber-soled shoes. (To insulate you from earth so that even if you accidentally contact a live point, current will not flow through your body to earth and hence you will be protected from **electrical** shock)

4. Wear laboratory-coat and avoid loose clothing. (Loose clothing may get caught on an equipment/instrument and this may lead to an accident particularly if the equipment happens to be a rotating machine)

5. Girl students should have their hair tucked under their coat or have it in a knot.

6. Do not wear any metallic rings, bangles, bracelets, wristwatches and neck chains. (When you move your hand/body, such conducting items may create short circuit or may ouch a live point and there by subject you **to electrical** shock)

7. Be certain that your hands are dry and that you are not standing on wet floor. (Wet parts of the body reduce the contact resistance there by increasing the severity of the shock)

8. Ensure that the power is OFF before you start connecting up the circuit. (Otherwise, you will betouching the live parts in the circuit)

9. Get your circuit diagram approved by the staff member and connect up the circuit strictly as per the approved circuit diagram.

10. Check power chords for any sign of damage and be certain that the chords use **safety** plugs and do not defeat the **safety** feature of these plugs by using ungrounded plugs.

11. When using connection leads, check for any insulation damage in the leads and avoid such defective leads.

12. Do not defeat any **safety** devices such as fuse or circuit breaker by shorting across it. **Safety** devices protect YOU and your equipment.

13. Switch on the power to your circuit and equipment only after getting them checked up and approved by the staff member.

<table>
<tr><th>Course code</th><th colspan="4">Course title</th><th colspan="2"></th><th>Core/Elective</th></tr>
<tr><td>U23EE2L1</td><td colspan="6">BASIC ELECTRICAL ENGINEERING LAB
(Common for all branches)</td><td>Core</td></tr>
<tr><td rowspan="3">Pre-requisites
....</td><td colspan="4">ContactHoursPerWeek</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>3</td><td>25</td><td>50</td><td>2</td></tr>
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Course objectives:

1. Understand the basic concepts of ohms law and theorems with DC excitation.
2. Understand the concepts of self and mutual inductance, coefficient of coupling.
3. Identify Sinusoidal steady state response of R-L, and R-C circuits.
4. Understand the different phenomenon for balanced three phase circuit connected in Star and Delta.
5. Understand the characteristics of DC and AC Machine and performance of Single phase transformer.

Course outcomes:

1. Verify the ohms law and theorems by practical and theoretical calculations.
2. Evaluate of self and mutual inductance, coefficient of coupling.
3. Explain the Sinusoidal steady state response of R-L, and R-C circuits.
4. Analyze the different phenomenon for balanced three phase circuit connected in Star and Delta.
5. Identify the different characteristics of DC and AC Machine and perform tests on Single phase transformer.

Demonstration - 1: Basic safety precautions, Introduction and use of measuring instruments, Voltmeter, Ammeter, Multi-meter, Oscilloscope, Real-life resistors, Capacitors and Inductors.

1. Verification of Ohm's Law, KVL and KCL.
2. Verification of Super position theorem (with DC excitation).
3. Verification of Thevenin's and Norton's theorems (with DC Excitation).
4. Determination of self and mutual inductance, co-efficient of coupling.
5. Sinusoidal steady state response of R-L, and R-C circuits.

Demonstration – 2: Demonstration of cut-out sections of Machines: DC Machine (Commutator- brush arrangement), Transformers, Induction Machine (Squirrel cage rotor), Synchronous Machine (Field winging- slip ring arrangement) and Single-Phase Induction Machine.

1. Measurement of phase voltage/current, line voltage/current and power in a balanced three-phase circuit connected in star and delta.
2. OCC characteristics of DC Generator.
3. Transformers: Observation of the no-load current wave form on an oscilloscope.
   (Non-sinusoidal wave-shape due to B-H curve non linearity should be shown along with a discussion about harmonics).
4. O.C test and S.C test on single phase Transformer.
5. Measurement of primary and secondary voltages, currents and power of a single-phase Transformer.
6. Open circuit and short circuit characteristics of an Alternator.
7. Power factor improvement of Induction Motor using static capacitor.

Note: It is mandatory to conduct any 8 experiments from the above list of experiments.

Suggested Readings:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019.
2. MS Naidu and S Kamakshaiah, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, 2008.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Do's

1 Get signature in your observation book from your teacher before leaving the lab

2 Perform only those experiments which you have been instructed

3 It is your responsibility to take care of lab equipment, use it only as instructed, and reportany damages to your teacher

4 Clean and dry your lab work area at the close of the lab period. Return allequipment and materials to the proper place.

5 Use ball points pens, not pencils for noting the observations.

6 Be honest. All procedures and experimental data whether you regard them as "good" or "bad" at the time should be recorded in the lab book.

7 Pleases take care your personal stuff with you (Backpacks, purses, calculators, keys, etc.). Do not leave them in the laboratory.

Don'ts

1 Never attempt to touch the equipment or to do the experiment onyour own until your teacher demonstrates about it.

2 Don't eat or drink in the laboratory at any time.

3 Don't chew gum or eat candy during laboratory exercises.

4 Don't be mischievous in the laboratory.

5 Never remove any pages from the observation notebook & record.

6 Never use electrical equipment around water.

7 Don't work in the lab alone.

8 Don't leave the bags and books in the aisles.

9 Don't touch the live wire.

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Signature of the Faculty

EXPERIMENT – 1

1A.VERIFICATION OF OHM'S LAW

AIM: To verify Ohm's law for a given resistive network

APPARATUS REQUIRED:

S. NO	Apparatus Name	Range	Type	Quantity
1	RPS	(0.20) V	DC	01
2	Voltmeter	(0-20) V	DC	01
3	Ammeter	(0-200) mA	DC	01
4	Resistor	1kΩ, 1.5kΩ, 2.2kΩ		Required
5	Ohms Law Kit	---	---	01
6	Connecting wires	---	---	Required

STATEMENT:

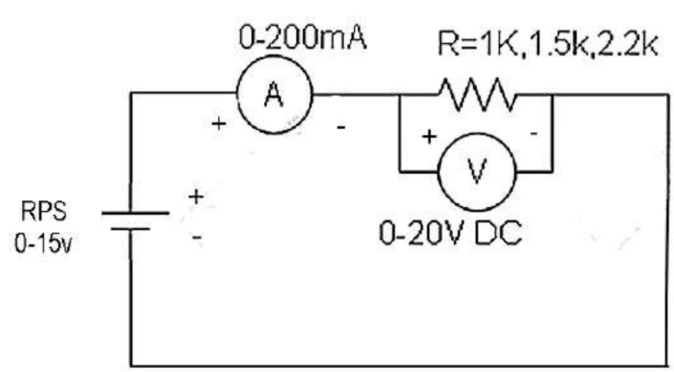
Ohm's law states that at constant temperature, the current flowing through a conductor between two points is directly proportional to the voltage across the two points.

$$I \propto V$$

$$I = \frac{V}{R}$$

$$\text{Resistance } R = \frac{V}{I}$$

CIRCUIT DIAGRAM:



PROCEDURE:

1. Make the connections as per circuit diagram for 1KΩ resistor.
2. Switch ON the power supply and apply a voltage of 5V with the help of RPS. Note down the reading of ammeter and voltmeter in the observation table.
3. Repeat the second step for 10V &15 V and tabulate the readings.
4. Repeat above steps for 1.5KΩ & 2.2KΩ resistances and tabulate the readings.
5. Plot a graph with V along x-axis and I along y-axis.
6. The graph will be a straight line which verifies Ohm's law.
7. Determine the slope of the V-I graph. The reciprocal of the slope gives resistance of the wire.

OBSERVATION TABLE:

S. No	Voltage, V(V)	Current, I(mA)	Resistance, R=V/I (KΩ)
1 KΩ resistance			
1			
2			
3			
1.5KΩ resistance			
1			
2			
3			
2.2KΩ resistance			
1			
2			
3			

CALCULATIONS:

For 1KΩ Resistor

V =

I =

$$\mathbf{R = \frac{V}{I} =}$$

For 1.5KΩ Resistor

V =

I =

$$\mathbf{R = \frac{V}{I} =}$$

For 2.2KΩ Resistor

V =

I =

$$\mathbf{R = \frac{V}{I} =}$$

MODEL GRAPH:

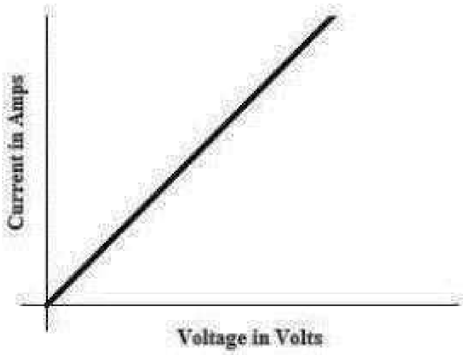


Fig : Voltage and Current Characteristics for
1KΩ,1.5KΩ &2.2KΩ

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.

RESULT:

LAB VIVA QUESTIONS

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?
7. What do you mean by junction?
8. What are the precautions to be taken while doing the experiment?
9. What is the range of ammeters and voltmeters you used in this experiment?
10. What are the limitations of ohm's law?

EXPERIMENT – 1

1B.VERIFICATION OF KVL AND KCL

AIM: To verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) in a Passive ResistiveNetwork

APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	Ammeter	(0-200) mA	DC	04
2	Voltmeter	(0.20)V	DC	03
3	R.P.S	(0-20)V	DC	01
4	KVL and KCL Kit	---	---	01
5	Resistors	1kΩ, 1.5kΩ, 2.2kΩ	Colour code	02each
6	Connecting Wires	---	---	As per required

KIRCHHOFF'S LAWS:

KVL: "The law states that the algebraic sum of voltages in a closed path is ZERO"

$$\sum (IR + e.m.f) = 0$$

KCL: "The law states that algebraic sum of currents meeting at a node or junction is equal to ZERO".

$$\sum I = 0$$

CIRCUIT DIAGRAMS:

KVL

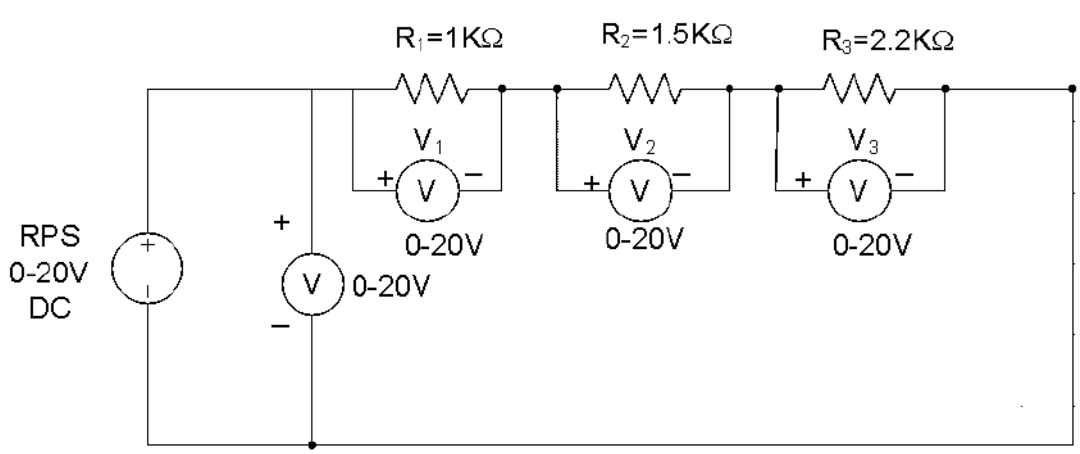


Fig. 1 Verification of KVL

KCL:

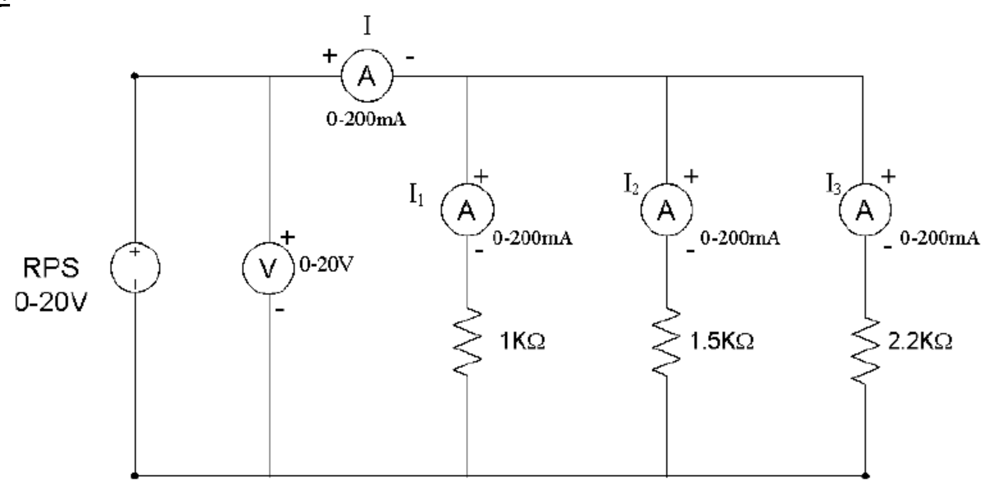


Fig.2 Verification of KCL

PROCEDURE:

KVL:

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

KCL:

1. Connect the circuit diagram as shown in Figure 2.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5v) and note the Ammeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of Ammeters.
6. Sum up the Ammeter readings (I_1,I_2 and I_3), that should be equal to total current (I).
7. Thus, KCL is Verified practically.

OBSERVATION TABLE:KVL:

V(volts)	V_1 (volts)	V_2 (volts)	V_3(volts)	Total Voltage,V	
				Practical Value $V = V_1 + V_2 + V_3$	Theoretical value V
5V					
10V					
15V					

THEORETICAL CALCULATIONS:KVL

V=5V

Current in the circuit, $I = \frac{V}{R1+R2+R3} = \frac{5}{1K+1.5K+2.2K} = 1.064\text{mA}$

$V_1 = I \times R_1 =$

$V_2 = I \times R_2 =$

$V_3 = I \times R_3 =$

$V = V_1 + V_2 + V_3 =$

OBSERVATION TABLE:KCL

V(V)	I (mA)	I_1 (mA)	I_2 (mA)	I_3(mA)	Total Current	
					Practical Value I= I1 + I2 + I3	Theoretical value I (A)
5V						
10V						
15V						

THEORETICAL CALCULATIONS:KCL

V=5V

$$\frac{1}{Req} = \frac{1}{1K} + \frac{1}{1.5K} + \frac{1}{2.2K} = 1 \times 10^{-3} + 0.667 \times 10^{-3} + 0.454 \times 10^{-3}$$

$$\frac{1}{Req} = 2.121 \times 10^{-3}$$

$$R_{eq} = \frac{1}{2.121 \times 10^{-3}} = 0.471 \times 10^{3} = 471\Omega$$

Total Current, $\mathbf{I} = \frac{V}{Req} = \frac{5}{471} = 0.0106$ A

PRECAUTIONS:

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

RESULT:

VIVA QUESTIONS

1. What is meant by node?
2. What is loop?
3. What is mesh?
4. State KCL.
5. State KVL.
6. What is node?
7. What is the difference between circuit and network?

EXPERIMENT - 2

VERIFICATION OF SUPERPOSITION THEOREM (With DC Excitation)

AIM: To Verify Superposition Theorem theoretically and practically

APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1.	Ammeter	(0-200) mA	MC	01
2.	R.P.S	(0-30) V	MC	02
3.	Superposition theorem kit	---	---	01
4.	Resistors	82Ω, 100Ω, 47Ω &56Ω	Fixed	Each 01
5.	Connecting Wires or probes	---		As required

STATEMENT:

Which states that in any linear network containing two or more sources, the response in any element is equal to the algebraic sum of the responses caused by the individual sources acting alone, while the other sources are reduced to zero".

CIRCUIT DIAGRAM:

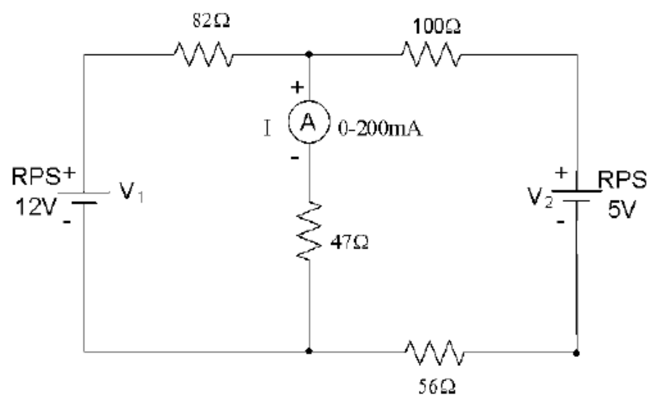


Fig:1-To calculate the load current

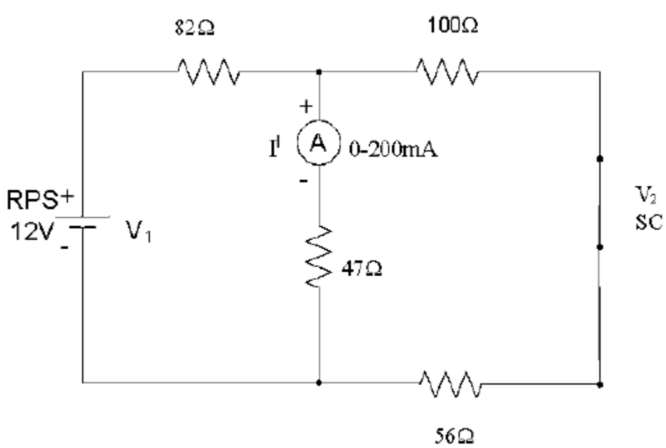


Fig.2-Considering V_1 alone

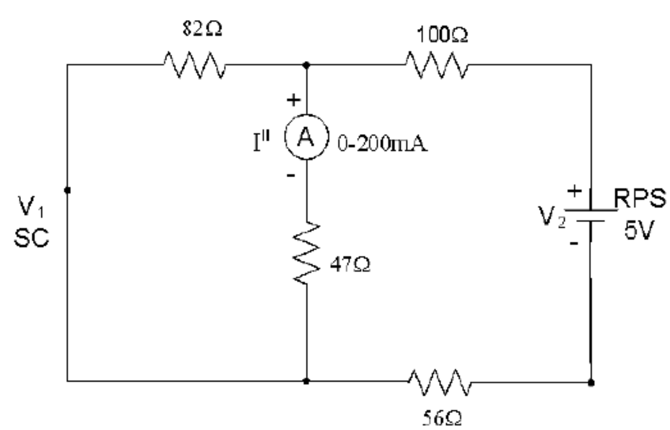
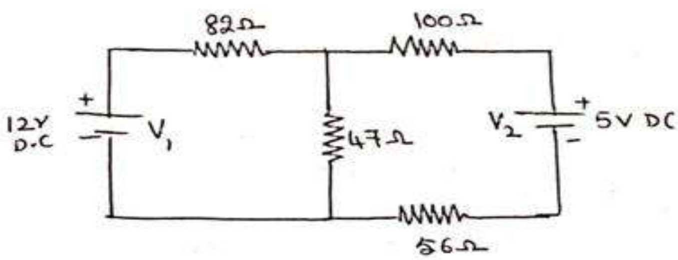


Fig:3-Considering V_2 alone

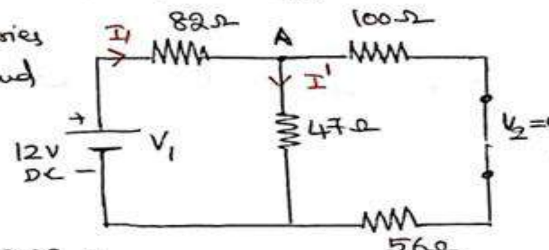
PROCEDURE:

1. Connect the circuit as shown in the circuit diagram figure (1).
2. Apply 12V in RPS1 and 5V in RPS 2.
3. Note down the ammeter reading as I.
4. Connect the circuit diagram as shown in fig (2).
5. Apply 12V in RPS1 and take the ammeter reading as I^1.
6. Connect the circuit diagram as shown in fig (3).
7. Apply 5V in RPS2 and take the ammeter reading as I^{II}.
8. According to super position theorem, $I=I^1+I^{11}$

Superposition theorem – Theoritical Calculations :-



Consider 12V source alone. Eleminating 5V voltage source by shortcircuiting it, the circuit becomes



100Ω and 56Ω are in series then parallel with 47Ω and resultant is series with 82Ω

$$R_{eq}=[(100+56)\|47]+82$$

$$= \frac{156\times47}{156+47}+82 = 118.12\ \Omega$$

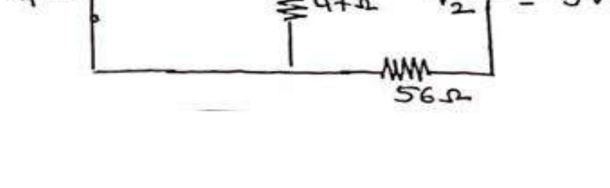
$$I_1 = \frac{V_1}{R_{eq}} = \frac{12}{118.12} = 0.1016A$$

Apply current division rule at point A,

$$\text{Current}, I' = I \cdot \frac{(100+56)}{100+56+47}$$

$$I' = 0.1016\times\frac{156}{203} = 0.078A$$

Now consider 5V source alone by reducing 12V source to zero i.e 12V source is short circuited.



82Ω and 47Ω are in Parallel, then Series with 100Ω and 56Ω resistors.

$$R_{eq} = \left[\frac{82\times 47}{82+47}\right] + \left[100+56\right]$$

$$= 185.87\,\Omega$$

Current $I_2 = \frac{V_2}{R_{eq}} = \frac{5}{185.87} = 0.027\,A$

Current through 47Ω resistor $I^{II} = I_2 \cdot \frac{82}{82+47}$

$$= 0.027 \cdot \frac{82}{129}$$

$$I^{II} = 0.017\,A$$

Total current through 47Ω resistor $I = I^{I} + I^{II}$

$$= 0.078 + 0.017$$

$$= 0.095A = 95\,mA$$

OBSERVATION TABLE:

Sl. No	Voltage V_1	Voltage V_2	Load Current	
			Theoretical	Practical (Ammeter reading)
1	12V	5V	$I = I^{I} + I^{II} =$	$I =$
2	12V	0V	$I^{I} =$	$I^{I} =$
3	0V	5V	$I^{II} =$	$I^{II} =$

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.

RESULT:

VIVA QUESTIONS:

1. To which network superposition theorem is applicable?
2. Superposition theorem is valid only for which networks?
3. State Super position theorem.
4. What is meant by elimination of sources?

EXPERIMENT – 3

3A.VERIFICATION OF THEVENIN'S THEOREM (With DC Excitation)

AIM: To Verify Thevenin's theorem theoretically and practically

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter	(0-200) mA	DC	01
2.	Voltmeter	(0-20) V	DC	01
3.	R.P.S	(0-30) V	DC	01
4.	Thevenin's Theorem Kit	---	---	01
5.	Resistors	82Ω, 47Ω,100 Ω, 150Ω	Fixed	04
6.	Connecting Wires	---	---	As required

STATEMENT:

"Any two terminal active linear network containing energy sources (generators) and resistances can be replaced with an equivalent circuit consisting of a voltage source Vth in series with a resistance R_{th}. The value of V_{th} is the open-circuit voltage between the terminals of the network and Rth is the resistance measured between the terminals with all the energy sources eliminated (but not their internal resistances)."

CIRCUIT DIAGRAMS:

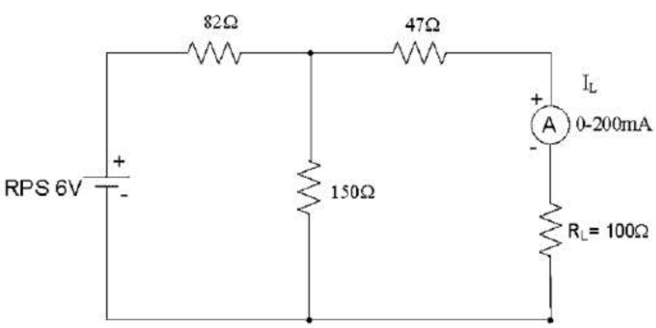


Fig-1 Measurement of I_L

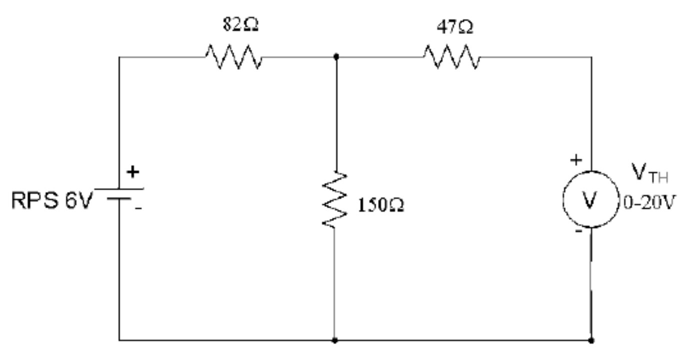


Fig – 2: Measurement of V_{TH}

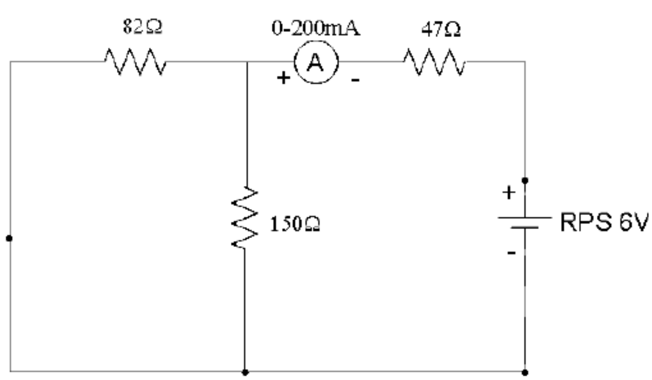


Fig – 3 Measurement of R_{TH}

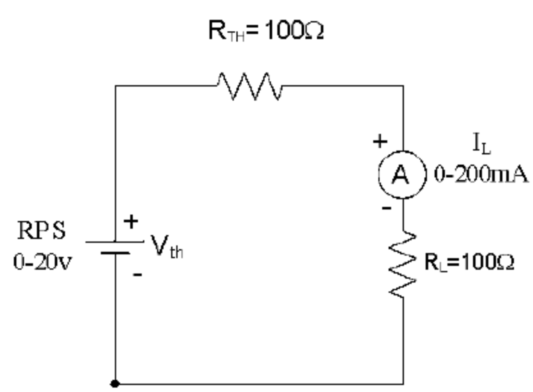


Fig – 4: Thevenin's equivalent circuit and Measurement of I_L

PROCEDURE:

1) Connect the circuit as shown in fig (1)
2) Switch on the supply and apply 6V.
3) Note down the reading of ammeter as I_1.
4) Connect the circuit as shown in fig. (2) and apply 6V.
5) Note down the voltmeter reading as V_{th}.
6) Connect the circuit as shown in fig. (3) and apply 6V.
7) Note down the reading of ammeter (I) and calculate R_{th} (R_{th}=V/I)
8) Now connect Thevenin's equivalent circuit as shown in fig. (4) and note down reading of ammeter as I_L.

OBSERVATION TABLE

Table-1: Original circuit

S.NO	Applied Voltage (V)	Ammeter Reading I_L(mA)

Table-2: To find Vth

S.NO	Applied Voltage (V)	V_{th}(v)	
		Theoretical	practical

Table-3: To find Rth

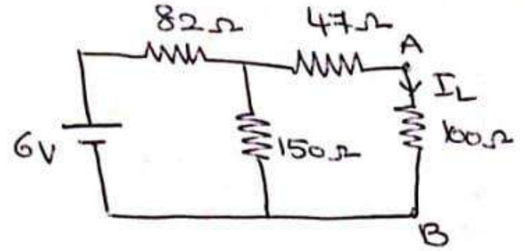
S.NO	Applied Voltage,V (V)	Current (I) mA	R_{th}	
			Theoretical	practical

Table-4: Thevenin's Equivalent circuit

S.NO	Applied Voltage (V)	Vth	Rth	I_L (mA)	
				Theoretical	practical

Theoretical Calculations:

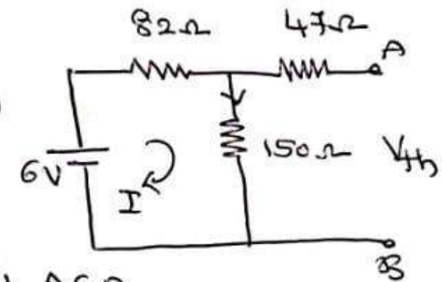
Theoritical Calculations – Thevenin's theorem



(i) Remove 100Ω resistor and find V_{th} between terminals A and B

No Current flowing through 47Ω resistor.

$V_{th} = V_{AB}$ is the thevenin voltage between terminals A & B



82Ω & 150Ω are in series, then

$$R_{eq} = 150 + 82 = 232\Omega$$

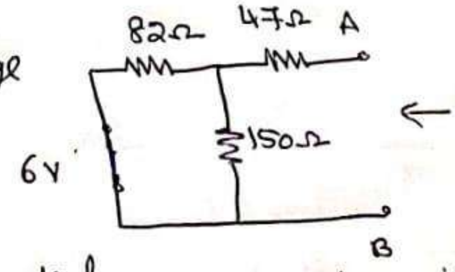
$$\text{Current}, \ I = \frac{V}{R_{eq}} = \frac{6}{232} = 0.026 \text{ A}$$

$$\text{voltage across } 150\Omega = I \times R = 0.026 \times 150 = 3.9V$$

$$V_{th} = \text{voltage across } 150\Omega = \underline{3.9 V}$$

(ii) To find R_{th}.

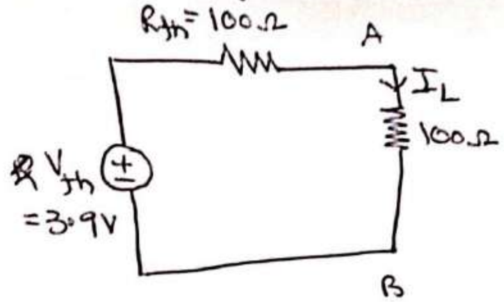
Reducing 6V voltage source to zero i.e short circuiting source terminals.



82Ω & 150Ω in Parallel, then in series with 47Ω

$$R_{th} = \frac{82 \times 150}{82 + 150} + 47 = \frac{12{,}300}{232} + 47 = 100\Omega.$$

Thevenin's equivalent circuit & reconnect Load resistance



$$\text{Load current, } I_L = \frac{V_{th}}{R_{th}+R_L} = \frac{3.9}{100+100} = 0.0195 \text{ A}$$

$$I_L = 0.0195 \text{ A (or) } \underline{19.5} \text{ mA}$$

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.

RESULT:

EXPERIMENT – 3
3B.VERIFICATION OF NORTON'S THEOREM

AIM: To Verify Norton's theorem theoretically and practically

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter	0-200 mA	DC	1
2.	Voltmeter	0-20V	DC	1
3.	R.P.S	0-00V	DC	1
4.	Norton's Theorem kit	---	---	1
5.	Resistors	82Ω, 47Ω,100Ω , 150Ω	CC	1 EACH
6.	Connecting Wires	---	---	As required

STATEMENT:

"Any two terminal linear active network containing energy sources (generators) and resistance can be replaced with an equivalent circuit consisting of a current source I_N in parallel with a resistance R_N. The value of I_N is the short-circuit current between the terminals of the network and R_N is the resistance measured between the terminals with all the energy sources eliminated (but not their internal resistances)."

CIRCUIT DIAGRAMS:

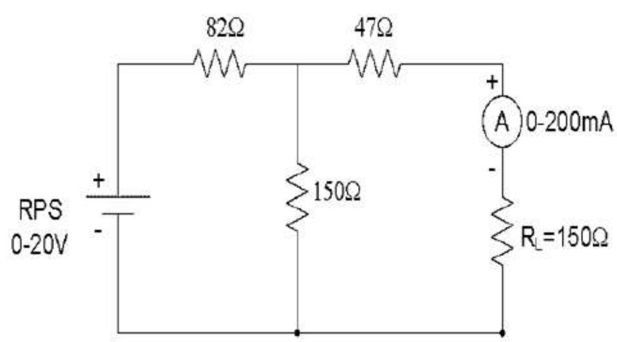


Fig.a Circuit for finding Load current

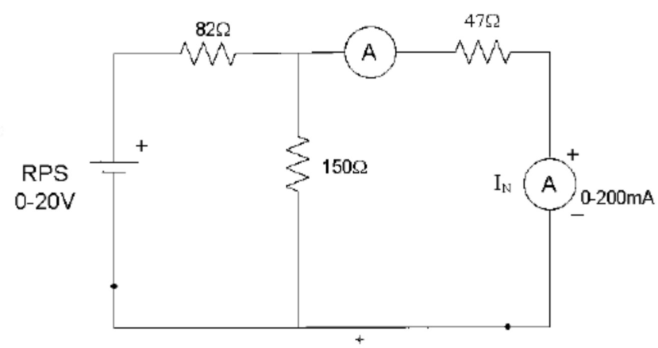


Fig.b: Circuit to find Norton's current

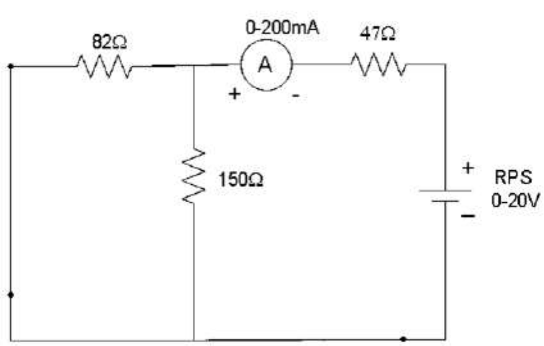


Fig (3) :To find R_N

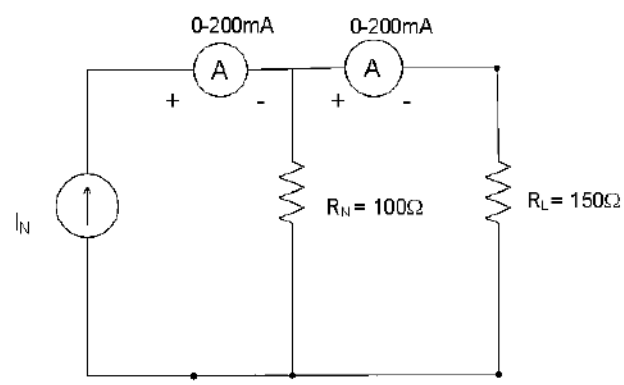


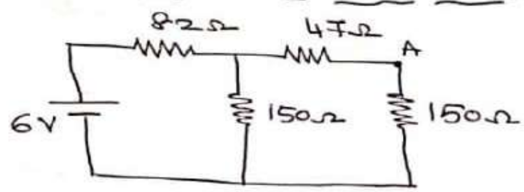
Fig (3) :Norton's equivalent circuit and finding I_L

PROCEDURE:

1. Connect the circuit as shown in fig(1)
2. Switch on the supply and apply 6V .
3. Note down the reading of ammeter as I_1.
4. Connect the circuit as shown in fig.(2) and apply 6V.
5. Note down the ammeter reading as I_N
6. Connect the circuit as shown in fig.(3) and apply 6V.
7. Note down the reading of ammeter as I. and calculate R_N. (R_N=V/I)
8. Now connect Norton's equivalent circuit as shown in fig.(4) and note down reading of ammeter as I_L.
9. According to Norton's theorem I_1=I_L

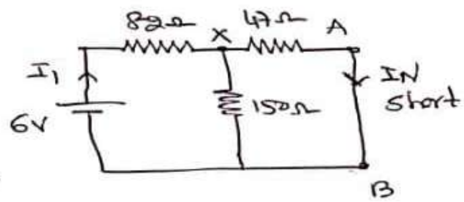
Theoritical Calculations:

Theoritical Calculations – Norton's theorem



To find I_N :-

Disconnect the load resistance and place a short across the terminals A & B. Find I_N through the short.



47Ω and 150Ω are in parallel, then in series with 82Ω

$$R_{eq} = \frac{47 \times 150}{47+150} + 82$$

$$= \frac{7050}{197} + 82 = 117.8\,\Omega$$

$$I_1 = \frac{V}{R_{eq}} = \frac{6}{117.8} = 0.0509\text{ A}$$

Apply current division rule at Point 'x'

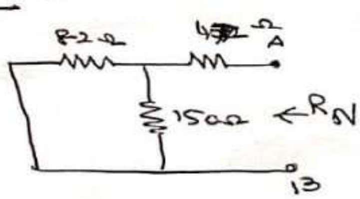
$$\text{Nortons current } I_N = I_1 \cdot \frac{150}{150+47}$$

$$= 0.0509 \times \frac{150}{197} = 0.0387$$

$$I_N = \underline{38.7}\text{ mA}$$

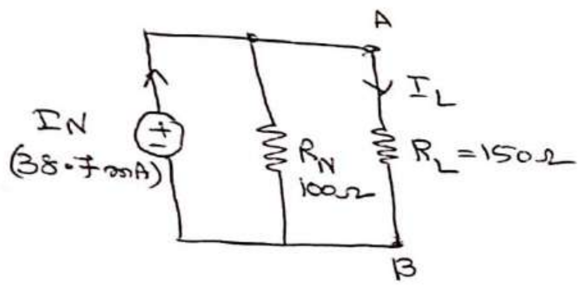
To find R_N :-

Reducing voltage source to zero



$$R_N = \frac{82 \times 150}{82+150} + 47 = 100\,\Omega$$

Nortons equivalent circuit and reconnect the load resistance.



Load Current, $I_L = I_N \cdot \frac{100}{100+150} = 38.7\times10^{-3} \times \frac{100}{250}$

$I_L = 0.0155$ A (or) 15.5 mA

TABULAR COLUMN:

Table-1: Original circuit

S.NO	Applied Voltage (V)	I_L(mA)	
		Theoretical	practical

Table-2: To find I_N

S.NO	Applied Voltage (V)	I_N(mA)	
		Theoretical	practical

Table-3: To find R_N

S.NO	Applied Voltage (V)	Current (I)	R_N	
			Theoretical	practical

Table-4: Norton’s Equivalent circuit

S.NO	Applied Voltage (V)	I_N	R_N	I_L(mA)	
				Theoretical	practical

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

RESULT:

VIVA-VOCE QUESTIONS:

1. What is the purpose of network theorems?
   Network theorems are useful in simplifying analysis of some circuits.
2. What is the use of Thevenin's theorem?
   It is widely used to analyze electronic circuits.
3. What is the dual of the Thevenin's theorem?
   Norton's theorem is the dual of the Thevenin's theorem.
4. What is Thevenin's voltage (Vth)?
   It is the open circuit voltage measured between the terminals of the network.
5. What is the Nortons resistance (R_N) ?
   It is the resistance measured between the terminals of the network with all energy sources eliminated.
6. What is Norton's short circuit current (I_N)?
   It is the current in the short placed between the terminals of the network.
7. Draw the Norton's equivalent circuit.

8. Draw the Thevenin's equivalent circuit.

EXPERIMENT – 4

DETERMINATION OF SELF AND MUTUAL INDUCTANCE COEFFICIENT OF COUPLING

AIM:

To determine self, mutual inductance and coefficient of coupling of mutually coupled circuit.

APPARATUS REQUIRED:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter	0-20A	MI	01
2.	Voltmeter	0-300V	MI	01
3.	Single phase Transformer	3 KVA		01
4.	Single Phase Variac	0-270V	AC	01
5.	Connecting Wires	---	---	As required

THEORY:

Self-inductance:

Coefficient of self-induction or self-inductance(L) is defined as the ability of a coil to induce an emf in it due to change in its own current. It is measured in Henry(H)

Self- inductance of Coil A, $L_1 = \frac{N_1\,\Phi_1}{\mathbf{I_1}} = \frac{N_1^2}{[l/\mu_0\,\mu_r\,a]}$

Self- inductance of Coil A, $L_2 = \frac{N_2\,\Phi_2}{\mathbf{I_2}} = \frac{N_2^2}{[l/\mu_0\,\mu_r\,a]}$

Mutual inductance:

Mutual inductance may be defined as the ability of one coil or circuit to induce an emf in a nearby coil by induction when the current flowing in the first coil is changed. The action is also reciprocal i.e. the change in current flowing through second coil will also induce an emf in the first coil. The ability of reciprocal induction is measured in terms of the coefficient of mutual induction M. Its unit is Henry.

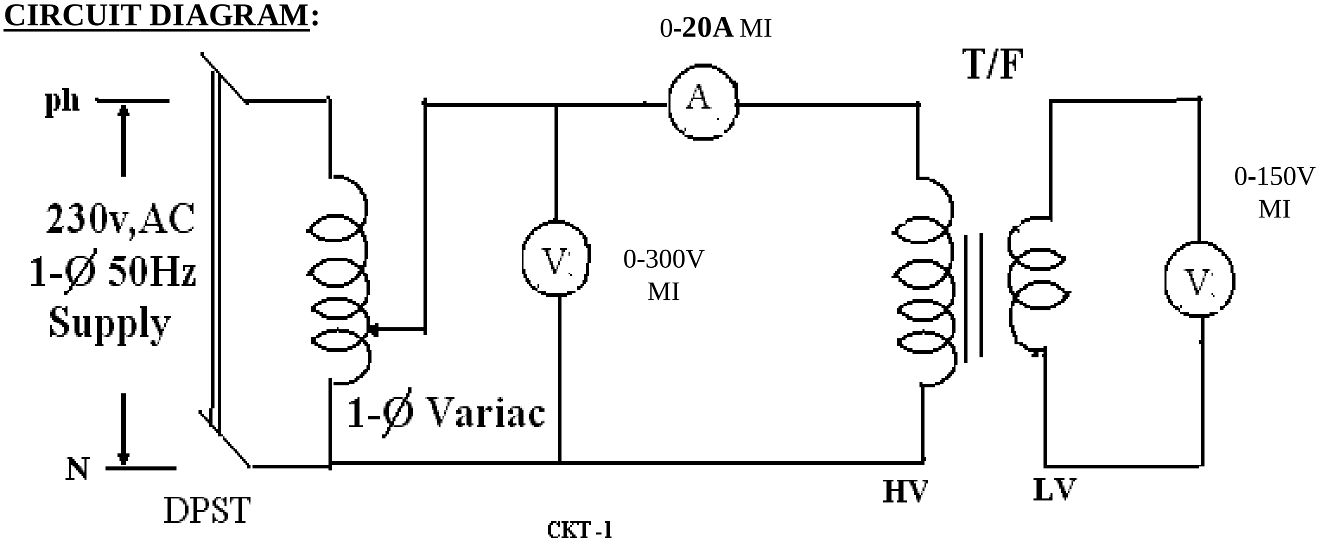
Coefficient of mutual inductance, $M = \frac{N_2\,\Phi_2}{\mathbf{I_1}} = \frac{K\,N_1\,N_2\,I_1}{[l/\mu_0\,\mu_r\,a]\,I_1} = \frac{K\,N_1\,N_2}{[l/\mu_0\,\mu_r\,a]}$

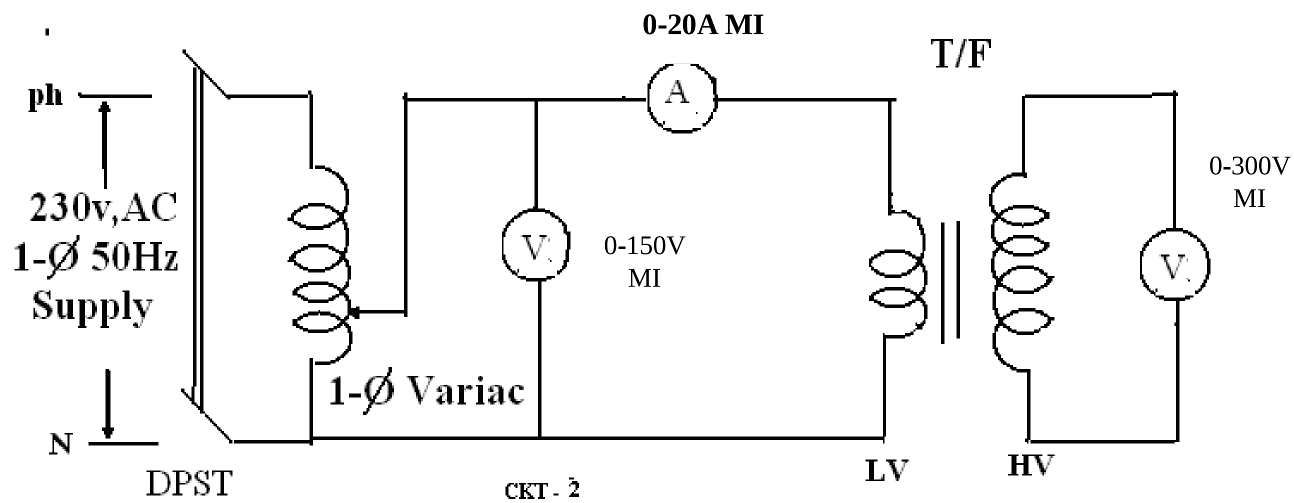
Coefficient of coupling:

When the two coils are placed near each other, all the flux produced by one coil does not link with the other coil, only a certain portion (say, K) of flux produced by one coil link with the other coil, K being less than unity. K is called the coefficient of coupling.

Coefficient of coupling, $K = \frac{M}{\sqrt{L_1 L_2}}$

CIRCUIT DIAGRAM:





PROCEDURE:

CIRCUIT-1

1. Connect the circuit as shown in the circuit diagram - 1.
2. Keep the variac output voltage in the minimum position.
3. Switch on the supply.
4. Vary the variac till rated voltage is obtained on the HV side.
5. Note down the readings of all the meters.

CIRCUIT-2

1. Connect the circuit as shown in the circuit diagram -2.
2. Keep the variac output voltage in the minimum position.
3. Switch on the supply.
4. Vary the variac till Rated is obtained on the LV side.
5. Note down the readings of all the meters

OBSERVATION TABLE:

CIRCUIT	I_1(A)	V_1(V)	V_2(V)	SELF INDUCTANCE(L)	MUTUAL INDUCTANCE (M)
CIRCUIT-1				L_1=	M_{12}=
CIRCUIT-2				L_2=	M_{21}=

CALCULATIONS:

CIRCUIT-1

Input impedance, $Z_1 = R_1 + j\omega L_1$

Neglecting resistance, then $\omega L_1 = \dfrac{V_1}{I_1}$ =

Self-inductance of HV coil, $L_1 = \dfrac{V_1}{\omega I_1}$ =

Mutual inductance , $M_{12} = \dfrac{V_2}{\omega I_1}$ =

CIRCUIT-2

Input impedance, $Z_2 = R_2 + j\omega L_2$

Neglecting resistance, then $\omega L_2 = \dfrac{V_1}{I_1}$ =

Self-inductance of LV coil, $L_2 = \dfrac{V_1}{\omega I_1}$ =

Mutual inductance, $M_{21} = \dfrac{V_2}{\omega I_1}$ =

Coefficient of coupling:

Mutual Inductance, $M = \dfrac{M_{12} + M_{21}}{2}$ =

L_1= L_2= M =

Coefficient of coupling, $K = \dfrac{M}{\sqrt{L_1 L_2}}$ =

PRECAUTIONS:

1. Connections should be made properly.
2. Always kept the variac output voltage in minimum position before and after switching on the supply.
3. Show connections to the lab faculty before you start the experiment
4. Note down the readings without parallax error.

RESULT:

Self-inductance of HV coil1,	L_1=
Self-inductance of LV coil 2,	L_2=
Mutual inductance	M_{12}=
Mutual inductance	M_{21}=
Coefficient of coupling	K=

Self, mutual inductance and coefficient of coupling of mutually coupled circuit is calculated.

VIVA QUESTIONS:

1. What is self-inductance of the coil?
2. What is mutual inductance of the coil?
3. What is coefficient of coupling?
4. Write the expression for inductive reactants of a coil?
5. Define self-induced EMF.
6. Define mutually induced emf
7. State Lenz's law.
8. Write the Faraday's laws of electromagnetic induction.

EXPERIMENT NO:5

SINUSOIDAL STEADY STATE RESPONSE OF R-L AND R-C CIRCUITS

AIM:

Calculating the impedance and Current of RL, RC and RLC series circuits.

APPARATUS REQUIRED:

Sl.No	Name of the Apparatus	Type	Range	Quantity Required
1	Voltmeter	AC	0-20V	3
2	Ammeter	AC	0-200mA	1
3	Resistor	CC	1kΩ,680Ω,330Ω	1
4	Inductor		100mH,33mH,10mH	1
5	Capacitor		1 µF,10µF,4.7µF	1
6	RL &RC KIT			1
7	Connecting Wires			As Required

THEORY:

Passive components in AC circuits behaves very differently than with connected in DC circuit due to the influence of frequency.

- In pure resistive circuit the current is in phase with the voltage.
  Φ=0   CosΦ=1 (Unity)
- In pure inductive circuit the current lags the applied voltage by 90 degrees.
  Φ=90 lagging   CosΦ=’0 ‘lagging
- In pure capacitor circuit, the current leads the applied voltage by 90 degrees.
  Φ=90 leading   CosΦ=’0 ‘leading
- In series RL circuit, the current lags applied voltage by angle Φ.
  0<Φ<90 lagging   1>CosΦ>0 lagging
- In series RC circuit the current leads applied voltage by angle of Φ.
  0<Φ<90 leading   1>CosΦ>0 leading
- In series RLC circuit he current either leads or lags the voltage by an angle of Φ.
  0<Φ<90 lag or lead   1>CosΦ>0 lag or lead

Impedance of series R-L circuit, Z= R+ j$X_L = \sqrt{R^2 + {X_L}^2}$ Ω

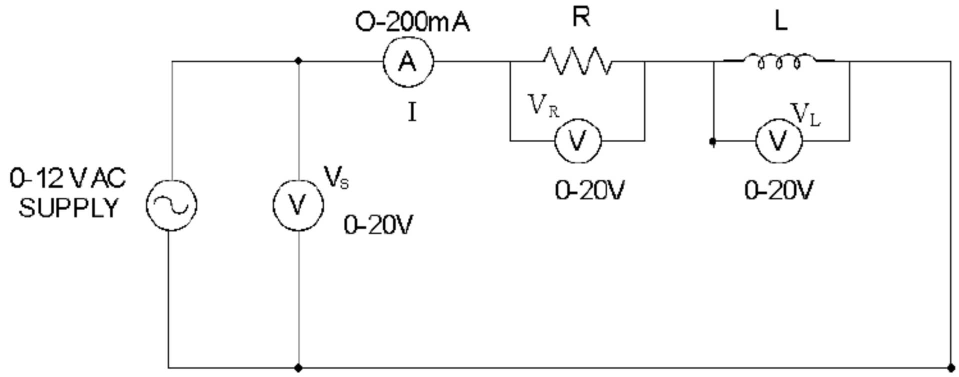
Impedance of series R-C circuit, Z=R+ j$X_C = \sqrt{R^2 + {X_C}^2}$ Ω

Impedance of series R-L-C circuit, Z = R+ j($X_L \sim X_C$) = $\sqrt{R^2 + (X_L \sim X_C)^2}$ Ω

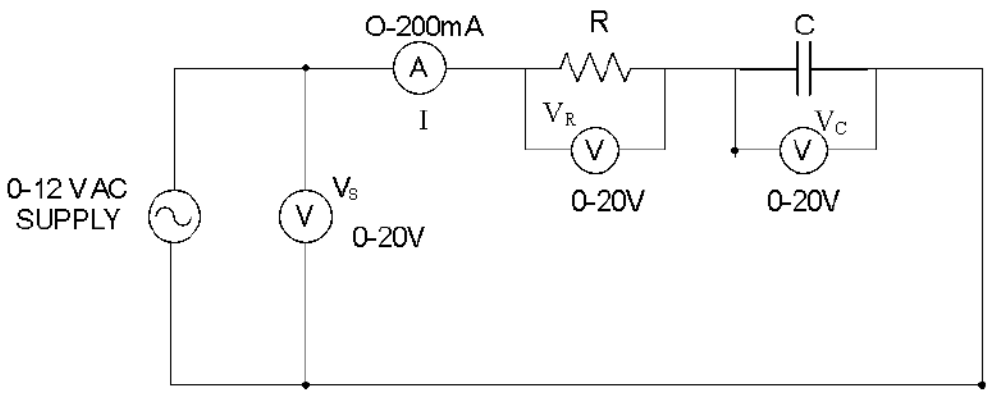
Impedance, Z= $\frac{V}{I}$ Ω

CIRCUIT DIAGRAM:

R-L Series Circuit:



R-C Series Circuit:



PROCEDURE: R-L Series Circuit:

1. Make the connections as per circuit diagram shown in fig (1).
2. Apply a suitable voltage by varying variac in steps.
3. Note all Ammeters and voltmeters readings and tabulate.
4. Calculate impedance Z, R, X_L, Cos Φ & P.

PROCEDURE: R-C Series Circuit:

1. Make the connections as per circuit diagram shown in fig (2).
2. Apply suitable voltage by varying variac in steps
3. Note all Ammeter and voltmeter readings and tabulate.
4. Calculate impedance Z, R, X_C, Cos Φ & P.

R-L Series Circuit:
Observation Table:

Sl.No	R	L	V_S (V)	V_R (V)	V_L(V)	I (mA)
1	1KΩ	100mH				
2	680Ω	33mH				
3	330Ω	10mH				

Calculations:

$Z=\frac{V_s}{I}$ Ω	$R=\frac{V_R}{I}$ Ω	$X_L=\frac{V_L}{I}$ Ω	Power Factor $Cos\Phi = \frac{R}{Z}$	Power P=V I Cos Φ Watts

R-C Series Circuit: Observation Table:

Sl.No	R	C	V_S (V)	V_R (V)	V_C(V)	I (mA)
1	1KΩ	10μF				
2	680Ω	4.7μF				
3	330Ω	1μF				

Calculations:

$Z=\frac{V_s}{I}$ Ω	$R=\frac{V_R}{I}$ Ω	$X_C=\frac{V_C}{I}$ Ω	Power Factor $Cos\Phi = \frac{R}{Z}$	Power P=V I cos Φ Watts

PRECAUTIONS:

1. Avoid loose connections.
2. Note down the readings carefully.

RESULT:

VIVA-VOCE QUESTIONS:

1. What is AC?
   The current whose magnitude and direction remain changing at a definite rate is called AC or alternating current.
2. What is meant by capacitive reactance?
   The opposition offered by a capacitor to the flow of AC through it is called capacitive reactance.
   $X_c = 1/2\pi fc$
3. What is meant by inductive reactance?
   The opposition offered by a coil to the flow of AC through it is called inductive reactance.
   $X_L = 2\pi fL$
4. What is meant by impedance?
   Impedance is the total opposition of the circuit to the flow of AC through it due to resistance, inductance and capacitance or either any two of these three quantities.
5. What is power factor?
   It is the cosine of the angle between voltage and current.
   It is the ratio of real power to the apparent power.
   It is the ratio of resistance to impedance.
6. What is the power factor of pure resistive circuit?
   Zero
7. What is the power dissipation of a pure inductive circuit?
   Zero
8. What is meant by power factor?
   It is the cosine of the angle between voltage and current.

EXPERIMENT 6

MEASUREMENT OF PHASE VOLTAGE/CURRENT, LINE VOLTAGE/CURRENT AND POWER IN A BALANCED THREE-PHASE CIRCUIT CONNECTED IN STAR AND DELTA

AIM: To measure phase voltage/current, line voltage/current and active and reactive power in Star and Delta connected balanced loads.

APPARATUS REQUIRED:

S. NO	Equipment	Range	Quantity
1	Digital voltmeter	0-500Volts AC	01
2	Digital ammeter	0-10Amps AC	01
3	Analog wattmeter	0-500V, 5Amps	01
4	R-Load bank.	Star/Delta Connected	01
5	Experiment setup	---	01
6	Connecting wires	---	As required

CIRCUIT DIAGRAM:

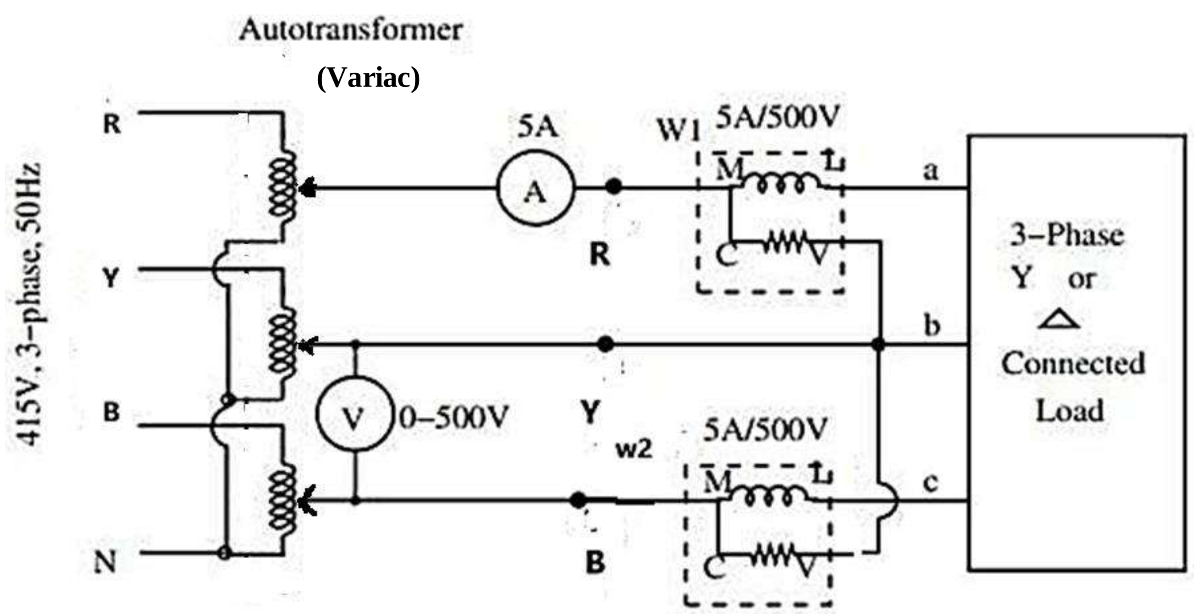


Fig. 1 Measurement of Three Phase Power Circuit Diagram

PROCEDURE: (For Balanced Loads)

1. Make the connections as per the circuit diagram for star connected load.
2. Switch ON the supply with help of MCB.
3. Apply voltage using three phase variac up to 400 Volts.
4. Note down the readings of voltmeter, ammeter and wattmeter.
5. Switch OFF the supply and disconnect the star Connected load.
6. Now repeat above steps for Delta connected load and note down the readings of various meters.

OBSERVATION TABLE:

Star Connection:

S. No	Voltmeter Reading (Line Voltage)	Ammeter Reading (Line Current)	Watt meter reading Power(w)	
	V_L (V)	I_L (A)	W_1	W_2

CALCULATIONS: Star Connection:

Line Voltage, V_L =

Phase Voltage, $V_{Ph} = V_L/\sqrt{3}$ =

Line Current I_L =

Phase Current, $I_{Ph} = I_L$ =

Wattmeter reading, W_1 =

Wattmeter reading, W_2 =

Active Power, $P = W_1+W_2$ =

Reactive Power, $Q=\sqrt{3}\,(W_1-W_2)$ =

Delta Connection:

S. No	Voltmeter Reading (Line Voltage)	Ammeter Reading (Line Current)	Watt meter reading Power(w)	
	V_L (V)	I_L (A)	W_1	W_2

CALCULATIONS- Delta Connection:

Line Voltage, V_L =

Phase Voltage, $V_{Ph} = V_L$ =

Line Current, I_L =

Phase Current, $I_{Ph} = I_L/\sqrt{3}$ =

Wattmeter reading, W_1 =

Wattmeter reading, W_2 =

Active Power, $P = W_1+W_2$ =

Reactive Power, $Q=\sqrt{3}\,(W_1-W_2)$ =

PRECAUTIONS:

1. Avoid loose/ wrong connections.
2. Switch off the supply after doing the experiment

RESULT:

LAB VIVA QUESTIONS

1. What is Phase Voltage?
2. What is Phase Current?
3. What is Line Voltage?
4. What is Line Current?
5. Write the relation between line and phase values of voltages and currents in star connection.
6. Write the relation between line and phase values of voltages and currents in Delta connection.
7. Write the expression for active power and reactive power in 3Φ system?

EXPERIMENT-7
O.C AND S.C TEST ON SINGLE- PHASE TRANSFORMER

AIM: To calculate the efficiency of a single-phase transformer by conducting OC and **SC** test.

APPARATUS:

S. No	Equipment	Type	Range	Quantity
1	Single phase Transformer	1Φ	3 KVA	1
2	Voltmeter	M.I	0-300 V 0-60 V	1 1
3	Ammeter	M.I	0-2 A 0-10A	1 1
4	Wattmeter	Dynamometer Type	300V,2A, LPF	1
5	Wattmeter	Dynamometer Type	150V ,10A, UPF	1
6	1-phase Variac		0-270 V	1
7	Connecting Wire	----	------	Required

TRANSFORMER SPECIFICATIONS:

S.No	Specifications	Rating
1	Transformer Rating (in KVA)	
2	Voltage on LV (in Volts)	
3	LV side current	
4	Voltage on HV (in Volts)	
5	HV side Current	
6	Type (Shell/Core)	
7	Frequency (Hz)	

Open circuit test:

In open circuit test, usually HV side is kept open and meters are connected on LV side, the ammeter reads the no load current Io and wattmeter reads the power input Wo. The no load current Io is 2 to 5 %of full load current. Hence the copper losses at no load are negligible. Wo represents the iron losses or core losses. Iron losses are the sum of hysteresis and eddy current losses.

$W_o = V_o I_o \cos\Phi_o$ $\qquad$ $\cos\Phi_o = W_o / (V_o I_o)$

$I_W = I_o \cos\Phi_o$ $\qquad$ $I_\mu = I_o \sin\Phi_o$

$R_o = V_o / I_w$ $\qquad$ $X_o = V_o / I_\mu$

Short circuit test:

This test is performed to determine the equivalent resistance and leakage reactance of the transformer and copper losses at full load condition. In this test usually LV side is shorted and meters are connected on HV side A variable low voltage is applied to the HV winding with the help of an auto transformer (Variac). This voltage is varied till the rated current flows. The voltage applied is 5 to 10% of rated voltage. While the rated current flows in the windings, the watt meter indicates the full load copper losses at Wsc. But the iron losses at this low voltage are negligible as compared to the iron losses at rated voltage.

Wsc =full load copper losses = $I_2^2 R_{02}$

$Z_{02} = V_{sc} / I_{sc}$ $\qquad X_{02} = \sqrt{(Z_{02}^2 - R_{02}^2)}$

CIRCUIT DIAGRAMS:

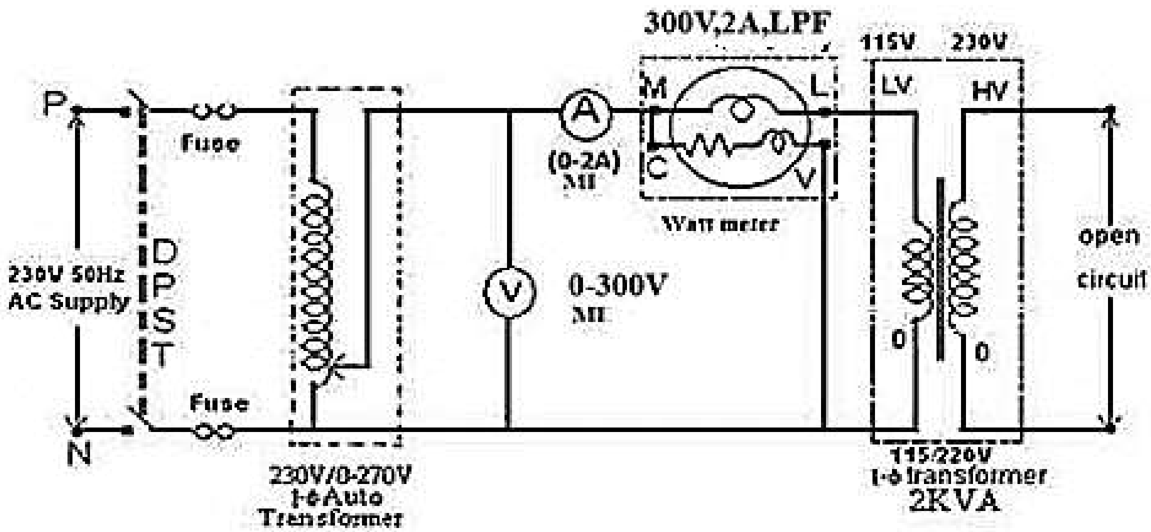


Fig. 1 OC Test Circuit Diagram

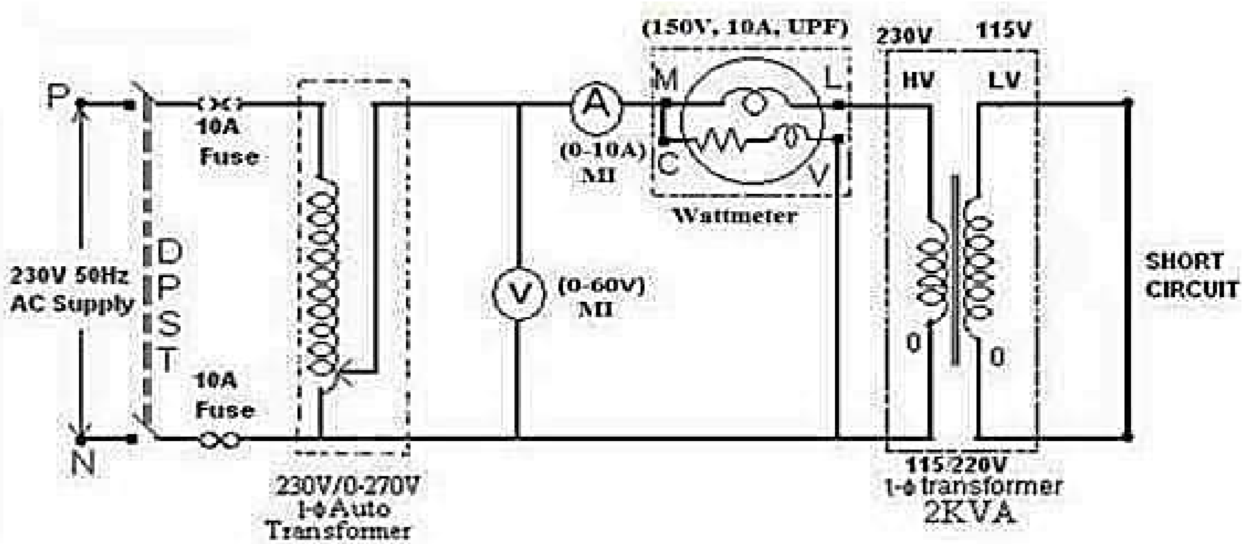


Fig. 2 : SC Test Circuit

PROCEDURE: OPEN CIRCUIT TEST:

1. Connections are made as per the circuit diagram shown in fig.1
2. By varying single phase variac, the rated input voltage to be applied on low voltage side of the transformer.
3. Now note down the readings of ammeter, voltmeter and wattmeter.
4. The ammeter indicates the no load current and wattmeter indicates the iron losses.
5. Reduce the voltage to zero by varying the variac and switch off the supply.

SHORT CIRCUIT TEST:

1. Connections are made as per the circuit diagram as shown in fig.2
2. Gradually increase the variac voltage till the ammeter reads rated current of the transformer on HV side.
3. Now take down the readings of voltmeter and wattmeter.
4. The ammeter indicates **Isc** (short circuit current), voltmeter indicates **Vsc** (short circuit voltage), and Wattmeter indicates **Wsc,** copper losses of the transformer at full load condition.
5. Reduce the voltage to zero by varying the variac and switch off the supply.

OBSERVATION TABLE:OPEN CIRCUIT TEST:

Multiplication Factor:

Open Circuit Primary Voltage V_o (volts)	Open Circuit Primary current I_o (Amps)	Open circuit Power W_o (watts)

SHORT- CIRCUIT TEST:

Multiplication Factor:

Short-Circuit Primary Voltage V_{SC} (volts)	Short-Circuit primary current I_{SC} (Amps)	Short-Circuit Power W_{SC} (watts)

CALCULATIONS:

From OC test

(1) Vo= (2) Io= (3) Wo=

Iron losses, $W_o = V_o I_o \cos\Phi_o$

$$\cos\Phi_o = \frac{W_o}{V_o I_o}$$

$I_w = I_o \cos\Phi_o$ $\qquad R_o = \frac{V_o}{I_w}$

$I_\mu = I_o \sin\Phi_o$ $\qquad X_o = \frac{V_o}{I_\mu}$.

From SC test

(1) I_{sc}= (2) V_{sc}= (3 W_{sc}=

Full load copper losses or variable losses, $W_{sc}=I_{sc}^2 R_{02}$

$R_{02}=W_{sc}/I_{sc}^2$

$Z_{02}=V_{sc}/I_{sc}$

$X_{02}=\sqrt{(Z_{02}^2-R_{02}^2)}$

Power factor ,p.f = $\cos\Phi = \frac{R_{02}}{Z_{02}}$

Efficiency calculation:

$$\textbf{\% Efficiency} = \frac{\text{KVA x P.f x100}}{\text{KVA x P.f x100+Iron Losses}(w_0)\text{+Full load Copper Losses}(W_{sc})} \text{ X 100}$$

PRECAUTIONS:

1. Avoid the loose connections.
2. Avoid connecting of meters directly to the machines.
3. Switch OFF the supply before making the connections.
4. Do not touch the bare conductors.
5. Avoid parallax error while making observations.

RESULT:

VIVA QUESTIONS:

1. What is a transformer?
2. Why transformer is rated in KVA?
3. What are the various losses present in a transformer?
4. What are the applications of transformer?
5. Why do you prefer to conduct O.C on LV side and SC test on HV side?
6. Why copper losses are negligible in OC test.

EXPERIMENT-8

MEASUREMENT OF PRIMARY AND SECONDARY VOLTAGES, CURRENTS AND POWER OF A SINGLE-PHASE TRANSFORMER

AIM:

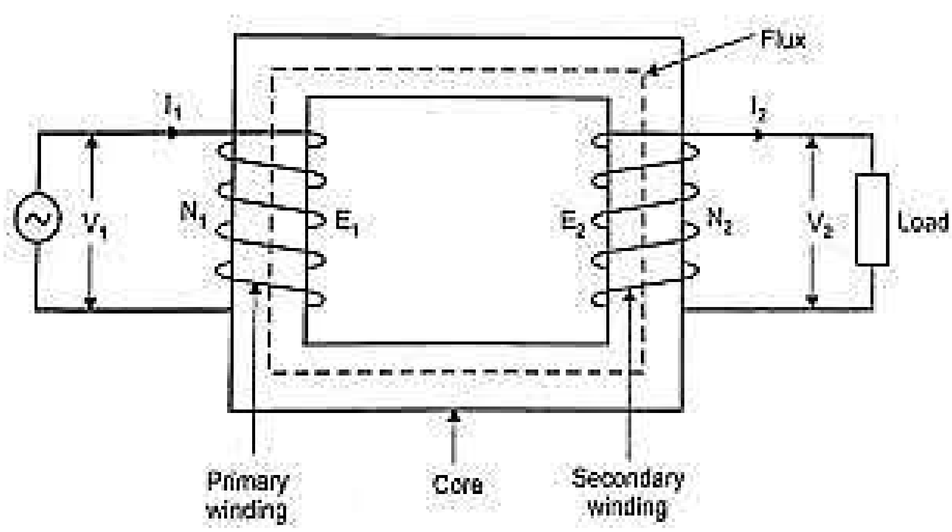
To measure voltage, current and power in primary and secondary circuits of a single-phase transformer by loading the transformer.

APPARATUS REQUIRED: -

Sl.No	Name of the Apparatus	Type	Range	Quantity Required
1	1ϕ Transformer	230/115V	1 KVA	1
2	Ammeter	MI	0-5A 0-10A	1 1
3	Voltmeter	MI	0-150V 0-300V	1 1
4	Wattmeter	UPF	300V,10A	2
5	1ϕ Variac	AC	0-270V	1
6	Resistive Load		5KW	1
7	Connecting Wires			As required

THEORY:

A transformer is a static device which transfers the electrical energy from one circuit to another circuit without any change in the frequency. The transformer works on the principle of electromagnetic induction between two windings placed on a common magnetic circuit. These two windings are electrically insulated from each other and also from the core.



NAME PLATE DETAILS OF TRANSFORMER:

Power Rating :

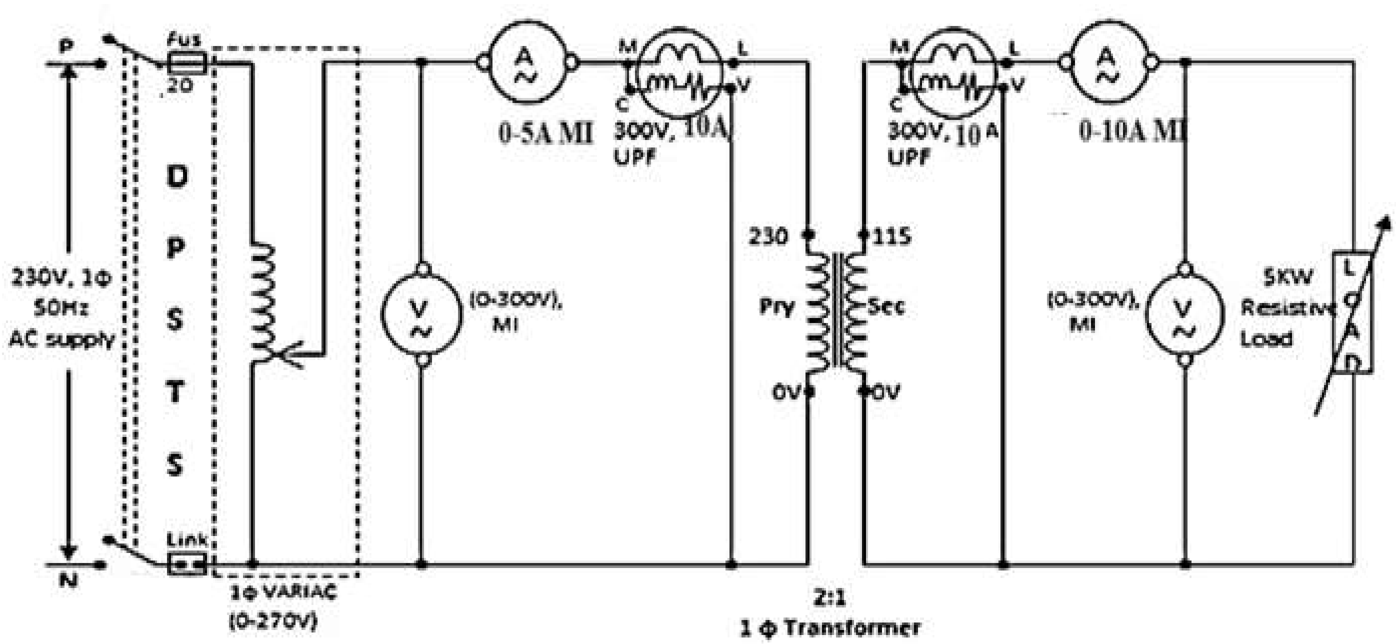
Primary Voltage :

Primary Current :

Secondary Voltage :

Secondary Current :

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the circuit as shown in the circuit diagram.
2. Put load in OFF position.
3. Switch on AC supply and gradually increases the voltage with help of variac up to 230V
4. Note down the readings of ammeter, voltmeter and wattmeter on both primary and secondary sides on no-load.
5. Now switch on the load and increase the load in steps up to full load current. Note down the readings of ammeter, voltmeter and wattmeter on primary and secondary for each step.
6. Now reduce the load to zero.
7. Bring back the variac to zero position and switch off the supply.

OBSERVATION TABLE:

Sl.NO	Primary Side			Secondary Side		
	Current (I_1) A	Voltage (V_1) V	Input Power (W_1) W	Current (I_2) A	Voltage (V_2) V	Output Power (W_2) W

PRECAUTIONS:

1. Avoid the loose connections.
2. Avoid connecting of meters directly to the machines.
3. Switch OFF the supply before making the connections.
4. Do not touch the bare conductors.
5. Avoid parallax error while making observations.

RESULTS:

Voltage, Current and power in primary and secondary of a single-phase transformer are measured and tabulated.

VIVA QUESTIONS:

1. On what principle the transformer works?.
2. What are the main parts of a transformer?
3. What are the types of transformers?
4. What is the meaning of the KVA rating of a transformer?
5. What is primary winding and secondary winding in transformer?

EXPERIMENT 9
O.C.C CHARACTERISTICS OF A D.C GENERATOR

Aim: To obtain open circuit characteristics of a dc shunt generator and to plot O.C.C

Apparatus Required:

S.no	Equipment	Range	Type	Quantity
1.	Voltmeter	0-300V	**DC**	2
2.	Ammeter	0-20A	DC	1
3.	Field regulator			1
4.	Tachometer	0-10000RPM		1
5.	Rheostat			1

Name plate details:

Terminal Voltage =

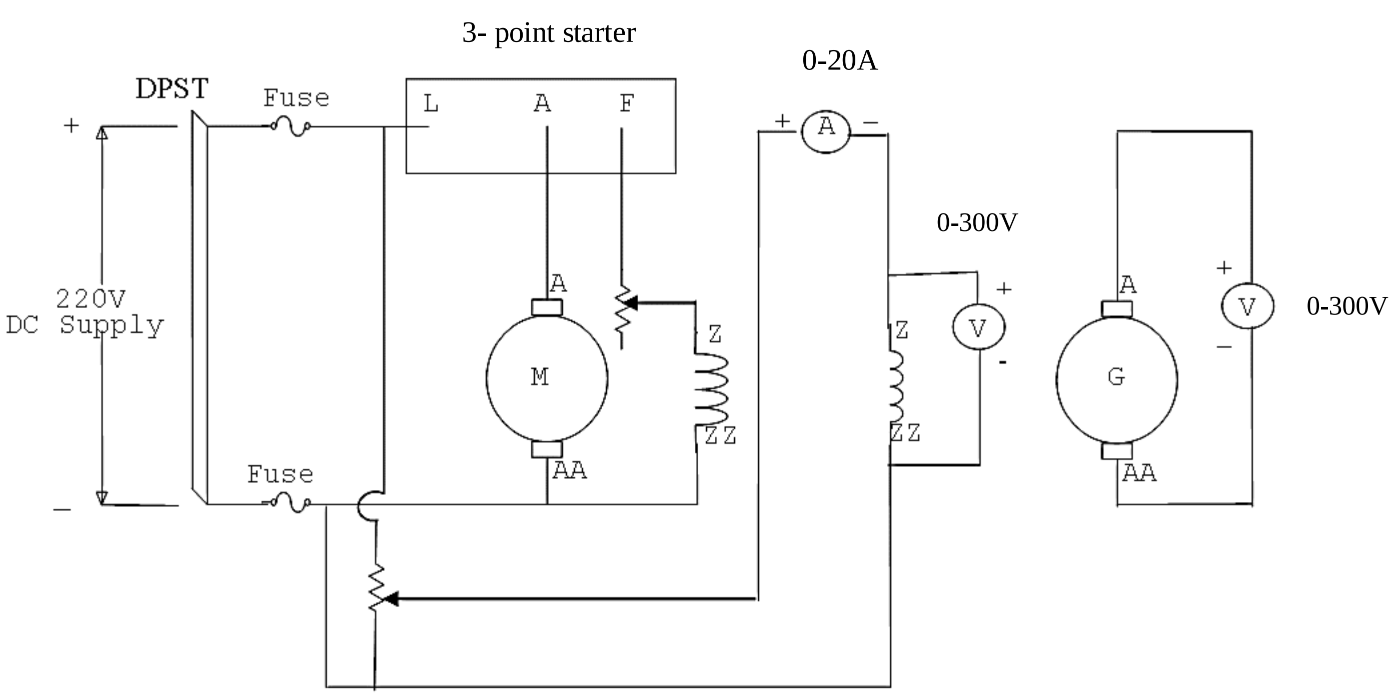
Power =

Line Current =

Field Current =

Speed =

Circuit Diagram:



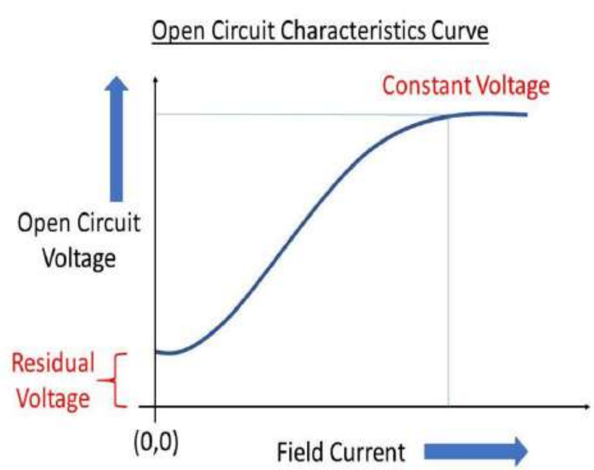
Procedure:

1. The connections are made as per the circuit diagram as shown in fig1.
2. The motor field rheostat is kept in minimum resistance position.
3. The potential divider supply to the generator field at minimum tapping position.
4. Switch on the supply, the motor is started slowly with help of starter.
5. The speed of the motor is adjusted to its rated speed by increasing the motor field rheostat resistance. This speed is kept constant throughout the experiment.
6. The value of E_0 at $I_f = 0$ is noted . The field current is increased in steps by increasing the tapping of the potential divider and simultaneously the reading of the field ammeter, voltmeter and voltage across the armature of generator are noted.
7. The above process is continued until the induced emf comes to saturation.
8. Plot the graph between E_f Vs I_f .

Observation Table:

S.no	Field Voltage (V_f)	Field current (I_f)	Open circuit voltage (E_O)

Model Graph:



Precautions:

1. The experiment should be done at constant speed.
2. At zero field current there should be some emf due to residual magnetism in the field poles, otherwise, the generator field terminals should be reversed.

Result:

Viva Questions & Answers

1) What is O.C.C?

O.C.C is an open circuit characteristic which gives the relation between no load induced EMF in the armature and field current at a given speed.

2) What do you mean by critical field resistance?

It is defined as the maximum field circuit resistance with to induce an EMF in a shunt machine. (Or) the value of field circuit resistance where the dc shunt generator fail to excite.

3) What do you mean by critical speed?

It is defined as the minimum required value of speed to excite and induce the emf in a dc generator.

4) What the different types of Generators?

i) Separately exited

ii) Self exited

a) Shunt generator

b) Series generator

c) Compound generator

5) What are the other names for O.C.C?

Open circuit characteristics are also known as magnetic characteristics or no load saturation characteristics.

6) Why the OCC characteristics does not start from origin ?

Due to residual magnetism.

7) What is the function of the starter in a DC motor?

Starter is used to limit the starting current.

8) How is the OCC at different speed plotted. Why ?

E_f proportional to N

OCC curves of shunt generator are used to determine the rate of change of no-load terminal voltage with variation of I_f, and to find the critical speed.

9) What happens when a D.C motor is connected across an A.C supply?

1. The motor will run but it would not carry same load as it would on d.c supply.
2. More sparking at the brushes
3. Eddy currents will be high and will cause overheating and may eventually burn on a.c supply

10) What will happen if the direction of current at the terminals of a D.C Motor is reversed?

The direction of rotation of motor remains same.

EXPERIMENT NO.10
NO-LOAD CHARACTERISTICS OF THREE PHASE ALTERNATOR

AIM:

To draw the No-load characteristics of a three phase Alternator.

NAME PLATE DETAILS:

DC MOTOR	AC GENERATOR
Power :	Voltage :
Speed :	Power :
Armature voltage :	Current :
Fieled voltage :	Speed :
Armature current :	Frequency :
Field Current :	

APPARATUS:

S.No	Name of the Apparatus	Range	Type	Quantity
1.	Three phase Alternator	3-phase ,400V		**01**
2.	Ammeter	0-2 A	MC	01
3.	Ammeter	0-10/20 A	MI	01
4.	Voltmeter	0-300/600 V	MI	01
5.	Rheostat	1450Ω/0.5A	WW	01
6	Rheostat	1450Ω/0.5A or 1850 Ω/0.5A	WW	01
7	Tachometer	0-9999 rpm		01
8	Connecting wires	-		-

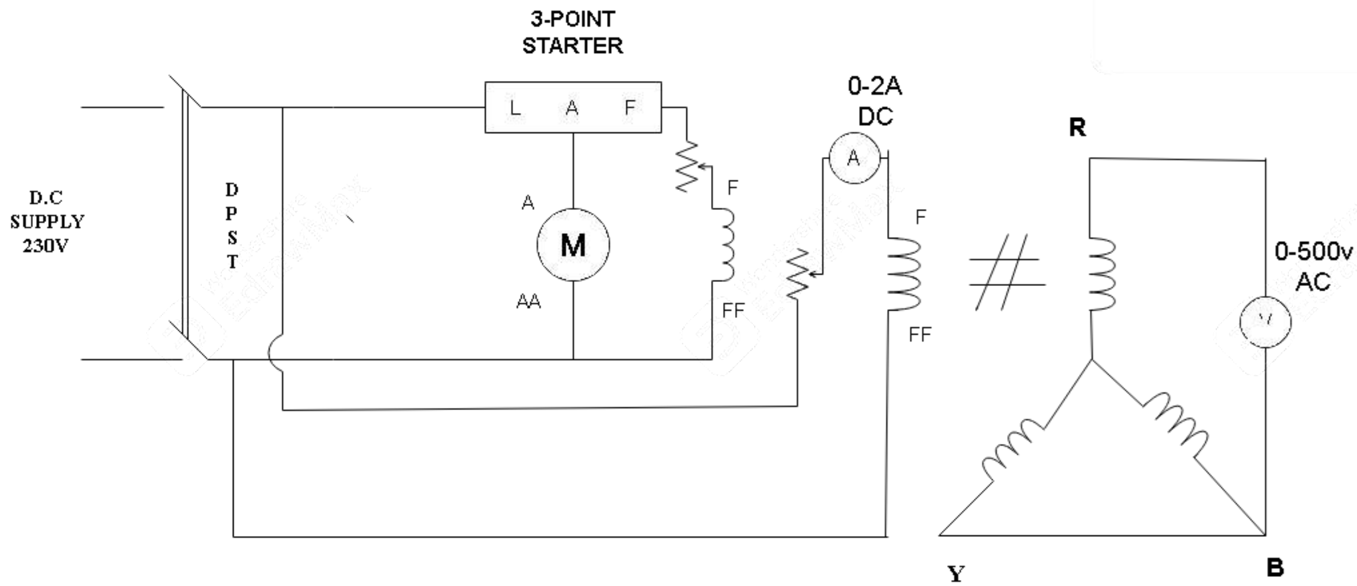
THEORY:

OCC (Open circuit characteristics): No-Load Characteristics:

For getting the Open Circuit Characteristics of Synchronous Machine, the alternator is first driven at its rated speed and the open terminal voltage i.e. voltage across the armature terminal is noted by varying the field current. Thus Open Circuit Characteristic or OCC is basically the plot between the armature terminal voltage E_f versus field current If while keeping the speed of rotor at rated value. It shall be noted that for OCC, the final value of E_f shall be 125% of the rated voltage.

This is plotted by running the machine on no load and by noting the values of induced voltage and field excitation current it is just like B- H curve.

Circuit Diagram:

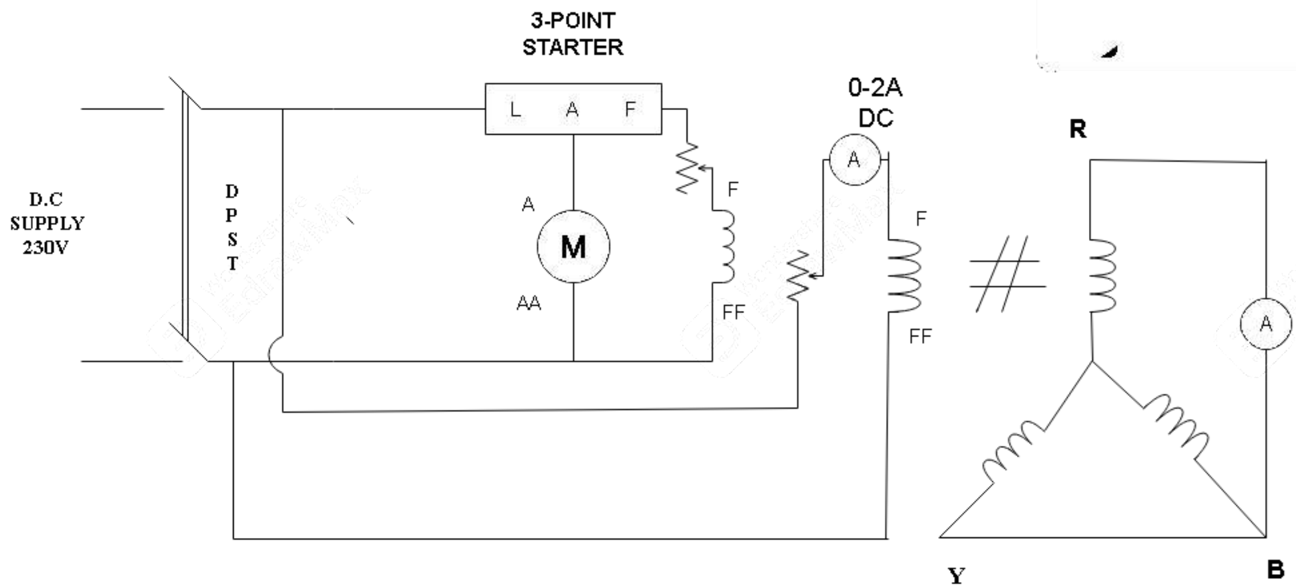


PROCEDURE:

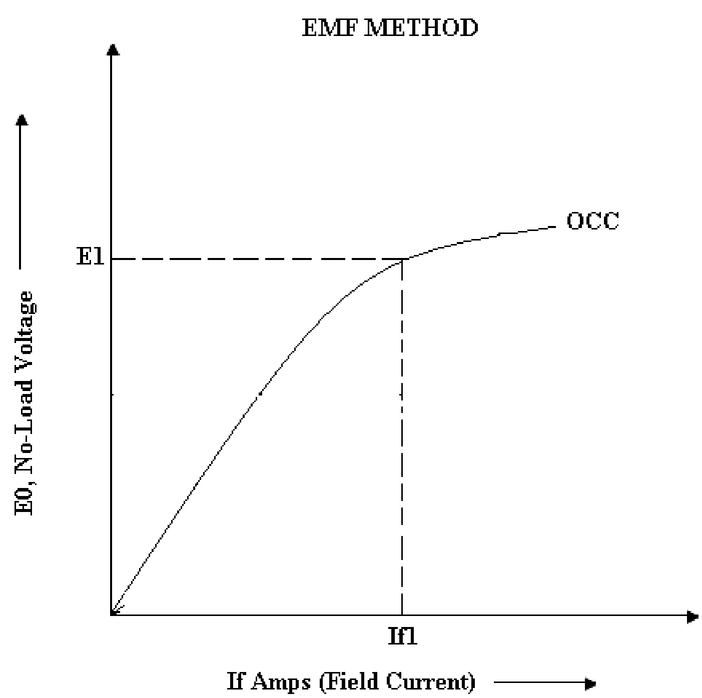
1. Connect the circuit as shown in circuit diagram.
2. The field rheostat of the motor should be at minimum position and field rheostat of the alternator at maximum position.
3. Switch on the DC supply and start the motor with 3 points starter.
4. Adjust the rheostat of the motor to set the motor-alternator set to the rated speed by increasing the value of field resistance of the motor circuit.
5. By decreasing the value of rheostat, increasing the field excitation of the alternator, note down the values of field current and voltage until the rated voltage reached by increasing the field current gradually to 0.5 amperes.
6. Bring back the field rheostat to the initial position i.e field rheostat of the motor to minimum position and that of alternator to maximum position respectively before switching off the supply.
7. Plot the graph between field current and voltage.

OBSERVATION TABLE:

Sl.NO	Field current, I_f (A)	No-Load Line voltage, V_L (V)	No-load Phase Voltage $V_{ph}=V_L/\sqrt{3}$



Model Graph:



Precautions:

1. Avoid loose connections.
2. Note down the readings without parallax error.

Result:

No-load characteristics of 3 phase alternator is plotted.