EXPERIMENT NO. 2

NAME OF THE EXPERIMENT : Verification of Thevenin's Theorem.

APPARATUS REQUIRED :
- Variac (250 V , 50 Hz)
- Voltmeter (AC, 0-600V)
- Ammeter (5 Amp)
- Resistances - 4 nos. (60 Ω , 40 Ω , 158 Ω , 190 Ω)
- Connecting Wires
- Multimeter.

THEORY :

A network with two terminals A and B can be replaced by a single voltage source V_{th} in series with a single resistance R_{th}. Where V_{th} is the open circuit voltage appearing between the terminals A and B when load has been disconnected. R_{th} is the equivalent resistance looking into the two terminals A and B with all power sources within the terminal pair removed. This is known as Thevenin's Theorem.

For the verification of Thevenin's theorem, the measurement of V_{th}, R_{th} and then the load resistance connected between A and B terminals and load current is measured.

OBSERVATION TABLE:

I_L

S. No	Vin (V)	V_{th} (V)	Isc (A)	$R_{th} = V_{th}/I_{sc}$	I_L (A)	I_L' (A)	$I_L - I_L'$ (A)	% error

PRECAUTIONS:

1. Connections should be tight and correct.
2. Variac must be adjusted properly.
3. Power should be off when the apparatus is not in use for taking reading, to avoid heating of apparatus.

Circuit Diagram

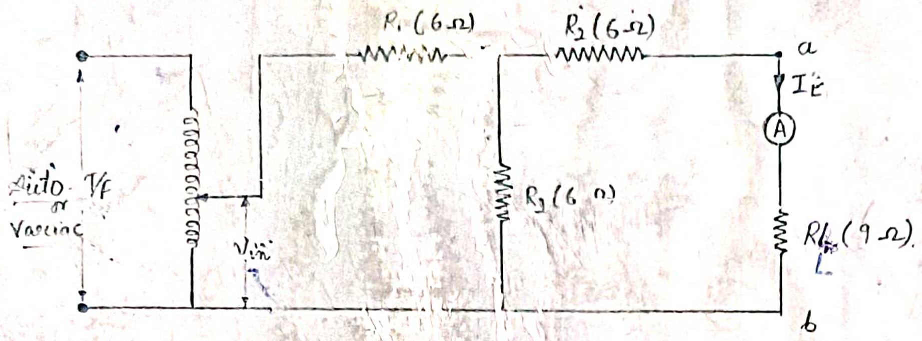


Fig. (a)

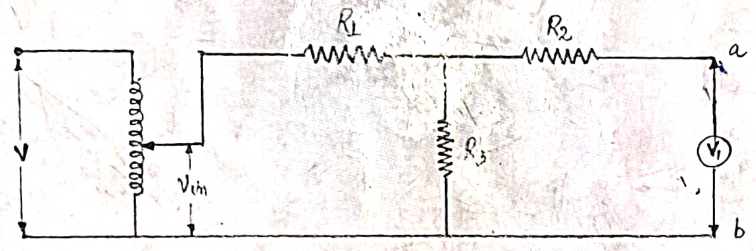


Fig. (b)

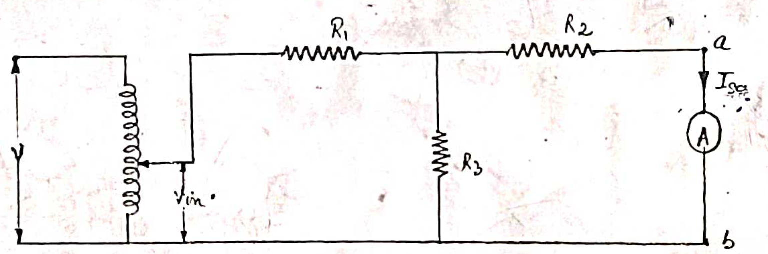


Fig. (c)

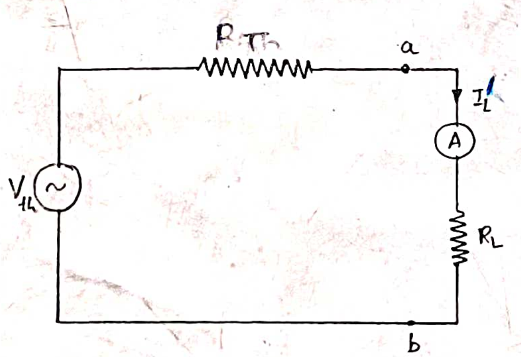


Fig (d). Thevenin's Equivalent Circuit

EXPERIMENT NO. 3

NAME OF THE EXPERIMENT : To assign polarity of single phase transformer and make its three phase connections.

APPARATUS REQUIRED :
1. Three transformers , $1\text{-}\phi$
2. Voltmeter (0-600V)
3. An A.C Source
4. Connecting wires.

THEORY :

To perform polarity test of the three given transformers:

One transformer is taken at one time and the connections are made as shown in the circuit diagram. A voltage V1 is applied between the joints A1 and A2. A second voltage V2 is measured across B1 and B2. One terminal of one A1 is connected with one terminal of the other B1 and voltage across the other two terminals, V3 is measured. V3 may be the sum or difference of the voltages V1 and V2. If same polarities are connected together then V3 is equal to V1-V2 and if opposite polarities are connected together, then V3 is equal to V1+V2. Thus we can assign polarity of single phase transformer.

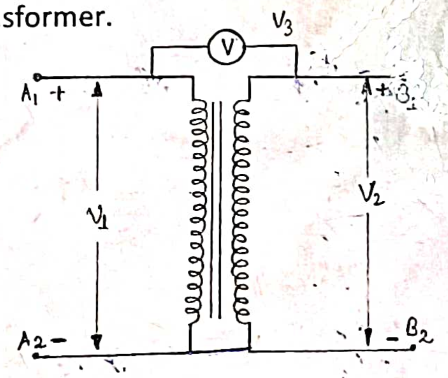


Fig.(a)

$V_3 = V_1 - V_2$

• Same Polarities are joined together.

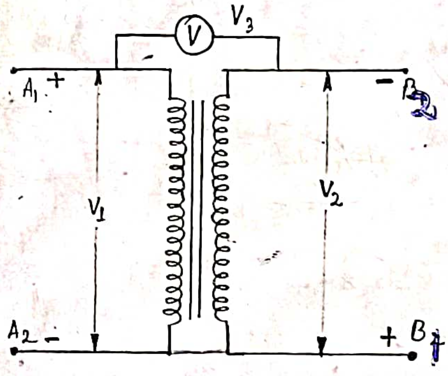


Fig (b)

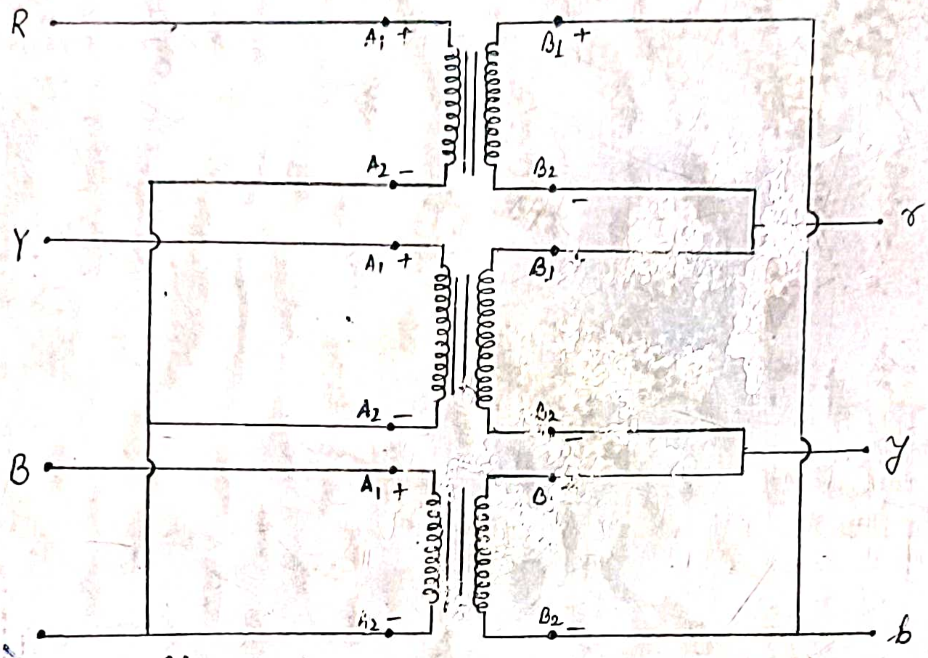
$V_3 = V_1 + V_2$

• Opposite Polarities are joined together.

To make the three phase connections:

The three single phase transformers are assigned polarities as explained earlier and they are connected as shown in figure. The primary windings are connected in star and secondary windings in delta connection. The primary is connected to ground neutral as shown in Figure. The ratio between secondary and primary line voltage is 1/√3 times the transformer ratio of each transformer. There is 30o phase shift between the primary and secondary line voltages which means star-delta transformer bank cannot be paralleled with either star-star or delta-delta bank. The voltages VRY, VYB, VRB and VBN are measured respectively under the Y-connection, and the line voltage and phase voltage is taken. Similarly Vby, Vry, Vbr are measured under the delta connection. The ratio is taken which ideally should be equal to one. The values are tabulated.

CIRCUIT DIAGRAM:



Y- Connection   Δ- connection

OBSERVATION TABLE:

TABLE -1 (Polarity Test)

S.No	TRANSFOR-MER	VOLTAGE V1	VOLTAGE V2	V3= V1+V2	V3= V1-V2
1.	T1				
2.	T2				
3.	T3				

TABLE-2 (Three phase connection)

Y-connection							Δ-connection			
VRY	VYB	VRB	VBN	VRN	VYN	VRY/ VBN	Vry	Vyb	Vbr	Vry/Vbr

PRECAUTIONS:

1. The three single phase transformers should not be connected arbitrarily. Polarity test must be done for any connection.
2. It is always advisable to mark the polarities on the transformer by means of chalk to ascertain that no mistake is committed.
3. The supply fed to primary of the transformer should never exceed the ratio of the transformer. So it is better to supply power through a three-phase Variac.

EXPERIMENT NO. 4

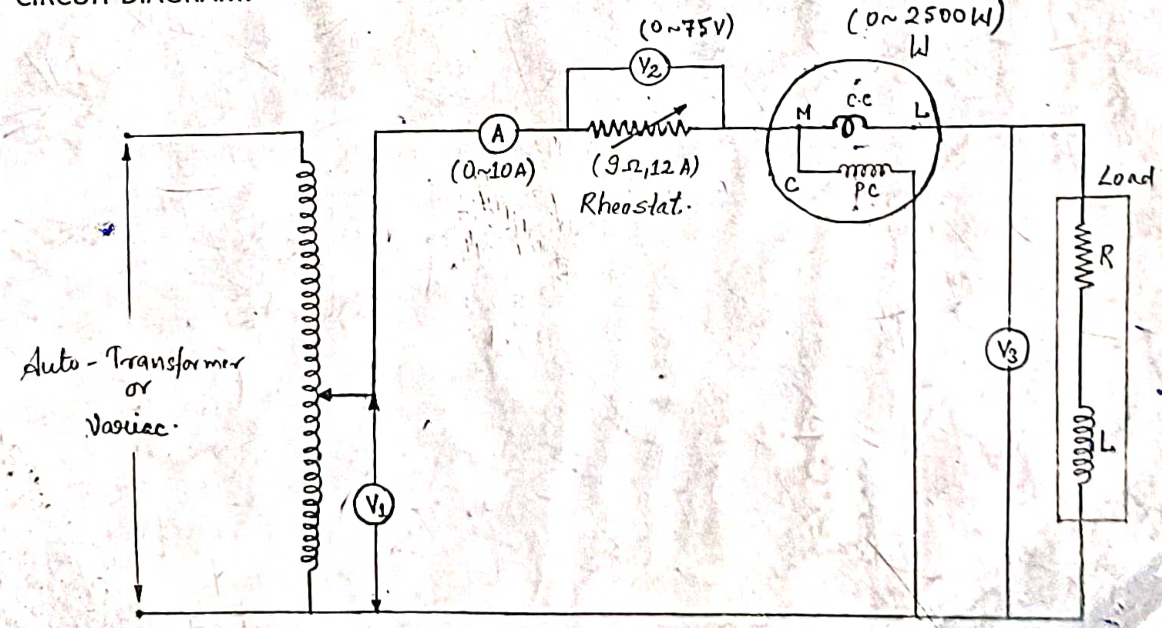
NAME OF THE EXPERIMENT : Measurement of single phase power and power factor by three voltmeter method and compare the result with wattmeter.

APPARATUS REQUIRED : Variac (250 V , 50 Hz)
Voltmeter - 3 nos. (AC, 300V)
Ammeter (5 Amp)
Rheostat
Load
Connecting Wires
Multimeter.

THEORY:
The power consumed by the load is given by the relation:
$P = V I \cos \phi$
Where , P= input power
V = voltage across the load impedance
I = effective circuit current.
ϕ=phase difference between the V and I.
and $\cos \phi$= power factor
the vector diagram is shown in fig. 1 and wattmeter readings are tabulated in the observation chart.

Let, V_1 = voltage drop across the combination
V_2= voltage drop across the rheostat
V_3= voltage drop across the rheostat load impedance.
ϕ=load power factor angle.
P= power observed by the load. $P = V_3 I \cos \phi$.

CIRCUIT DIAGRAM:



PROCEDURE:

First of all, connections are made as per circuit diagram.
Supply was given to the circuit.
Connect the voltmeter and ammeter as shown in the figure.
Readings are to be taken for two or three times and observations were taken by adjusting the rheostat.

OBSERVATION TABLE:

S. No	I (A)	V1 (V)	V2 (V)	V3 (V)	W (Watt)	Mf.	W×Mf (Watt)	cosϕ (three voltmeter)	cosϕ` (wattmeter)	%error	VR	VL

CALCULATION:

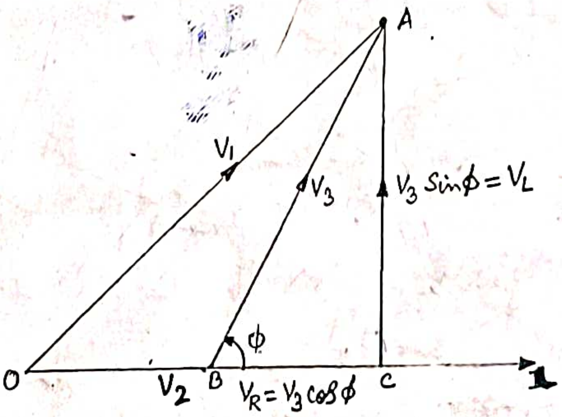
From right angled triangle OCA

$OA^2 = OC^2 + AC^2$

or, $V1^2 = (OB + BC)^2 + (V3sin\varphi)^2$

$V1^2 = (V2 + V3cos\varphi)^2 + (V3sin\varphi)^2$

And finally cosϕ= $\frac{V1^2 - V2^2 - V3^2}{2V2\,V3}$



PRECAUTIONS:

1. Connections should be made properly and tighten them.
2. Vs should not be greater than V_3
3. A.C power should be disconnected just after taking the readings in order to prevent damage of the electrical instruments.

EXPERIMENT NO. 5

NAME OF THE EXPERIMENT : No load characteristic of a DC Shunt generator.

AIM: To obtain and plot the no-load characteristic of a DC Shunt Generator.

APPARATUS REQUIRED :

- Ammeter (0-3 A)
- Voltmeter (0-300V)
- Rheostat (290 Ω)
- Tachometer (0-2000 rpm)
- Connecting wires.

THEORY :

The relation between no load generated e.m.f. in armature and the field exciting current I_f at a given speed is given by no load characteristic.
According to the circuit diagram, Ra is the armature Rheostat of D.C motor and Rf is the field Rheostat of D.C Motor.
For a D.C Generator the voltage equation is given by

$$Eg = \frac{\varphi ZN \times P}{60\,A}$$

And $Eg = Va + IaRa$

Where
- ϕ = flux density
- Z = total number of conductors
- P = no. of generator pole
- A = no. of parallel paths in armature
- N = speed in r.p.m

From above two equations

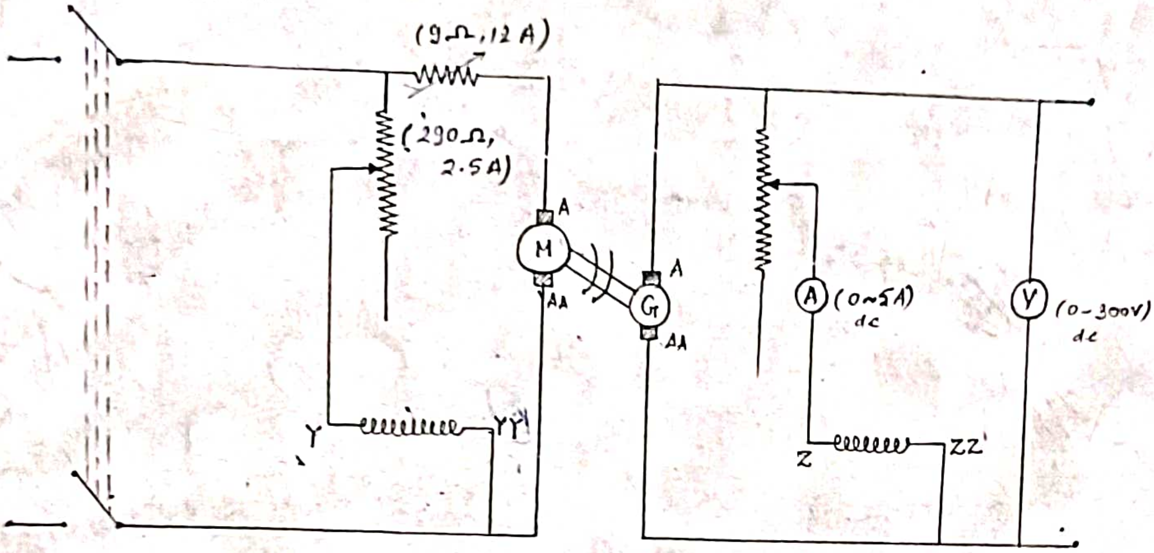
$$Eg = Ka\,\phi$$

It is obvious that when If is increased from its initial value, the flux and hence generated e.m.f. increases directly as current. But as the flux density increases the poles become saturated so greater increase in If is required to produce a given increase in voltage than previous one, due to which we get the saturation in V-I characteristic.

PROCEDURE:

1. Connect the circuit of motor and generator as per circuit diagram.
2. Initially we put Rf at its maximum value and rf as well as Ra at minimum & maximum respectively.
3. When motor M speeds up at rated speed cut Ra to zero slowly.
4. We adjust the field current of the generator by rheostat, so as to obtain rated voltage at no load.
5. For various values of current we take the generated voltage.

CIRCUIT DIAGRAM:



OBSERVATION TABLE:

INCREASING				DECREASING			
S. No	Field current I_f	Voltage (V)	Speed of motor, N	S. No	Field current I_f	Voltage (V)	Speed of motor, N
1.				1.			
2.				2.			
:							
.							
12.				12.			
13.				13.			

RESULT: The open load characteristic of DC shunt generator is plotted.
From the graph we observe that initially the nature was linear and later on saturation takes place.