

WORLD COLLEGE OF TECHNOLOGY AND  
MANAGEMENT,  
GURGAON (HARYANA)



ELECTRICAL TECHNOLOGY  
(EE-103-F)  
LAB MANUAL

I, II SEMESTER  
B. Tech.

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## EXPERIMENT NO 1

**AIM:** TO VERIFY KCL AND KVL.

**APPARATUS:** DC NETWORK KIT AND CONNECTING WIRES.

**THEORY:** KCL AND KVL are used to solve the electrical network, which are not solved by the simple electrical formula.

**KCL:** It states that in any electrical network the algebraic sum of currents meeting at a point is zero. Consider the case of few conductors meeting at a point A in the fig. Assuming incoming currents to be positive and the outgoing currents to be negative.

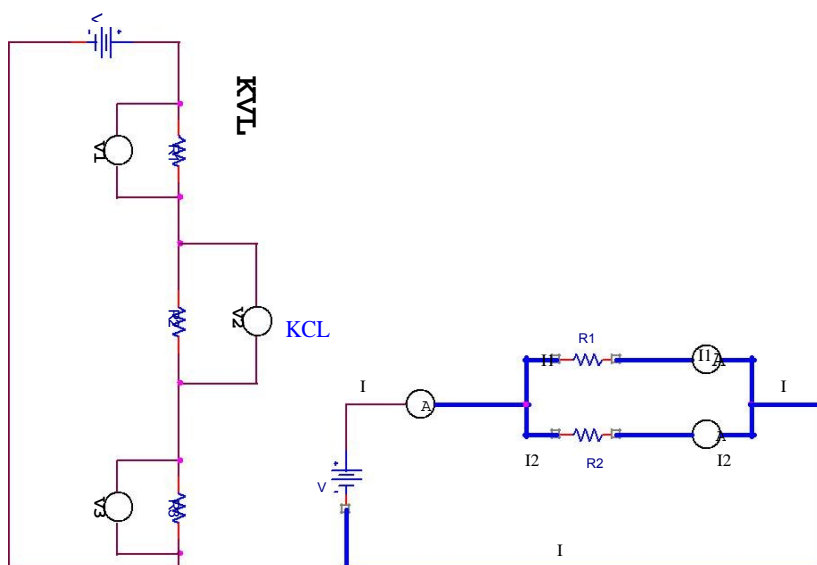
$$I_1 + (-I_2) + (-I_3) + I_4 + (-I_5) = 0$$

**Incoming current = outgoing current**

**KVL:** It states that the algebraic sum of product of current and resistance in each of the conductors in any closed path in a network plus the algebraic sum of the EMF. in the closed path is zero.

$$\sum IR + \sum E.M.F. = 0$$

### CIRCUIT DIAGRAM:



**PROCEDURE :****KCL:**

1. Make the connection according to the ckt diagram
2. Set the three rheostats to their max value.
3. Switch on the power supply
4. Change the setting of the rheostats to get different readings in all the three ammeters.
5. Measure the current in the three ammeters
6. Check that at every time current in the main branch is equal to the sum of currents in the two branches. repeat the setting of the rheostat
7. Switch off the power supply.

**KVL:**

1. Connect the circuit as per the circuit diagram
2. Switch on the power supply
3. Note down the readings of the voltmeters
4. Change the value of the rheostat and repeat the step several times and switch off the power supply.

**OBSERVATION TABLE:****KCL:**

SR.NO.	APPLIED VOLTAGE (volts)	$I_1$ (mA)	$I_2$ (mA)	$I$ (mA)	$I' = I_1 + I_2$ (mA)	REMARK

**KVL:**

SR.NO.	APPLIED VOLTAGE (volts)	$V_1$ (volts)	$V_2$ (volts)	$V_3$ (volts)	RESULT $V' = V_1 + V_2 + V_3$ (volts)	REMARK

**RESULT :**

1 The incoming current is found to be equal to the outgoing current

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2The total input voltage is equal to the total voltage drop in the ckt.

## **DISCUSSION:**

KCL AND KVL are very important in solving the circuits where direct formula can't be applied.

## **PRECAUTIONS :**

1. All connections should be tight and correct.
2. Switch off the supply when not in use.
3. Reading should be taken carefully.

## **QUESTIONS/ANSWERS:**

Q.1 What is the statement of Kirchhoff's first law?

A. The sum of the currents entering at any junction is equal to the sum of the currents leaving the junction.

Q.2 According to Kirchhoff's second law, the algebraic sum of all IR drops and emf's in any closed loop of a network is equal to...

A. It is equal to zero.

Q.3 Kirchhoff's second law is related to what?

A. EMF and IR drops.

Q.4 What is the internal resistance of the ideal voltage source? A. Zero

Q.5 What is higher, the terminal voltage or the emf?

A. The emf

Q.6 What is the internal resistance of the current source ideally?

A. Infinity

Q.7 What is the active network?

A. An active network is that which contains one or more than one sources of emf. or current sources

Q.8 What is the bilateral network?

A. It is the circuit whose properties are same in either direction

Q.9 What is the difference between a node and a branch?

A. A node is a junction in the circuit where two or more than two circuit elements are connected together. The part of the network, which lies between two junctions, is called branch.

Q.10 What is the non-linear circuit?

A. The circuit whose parameters change with the change in voltage and current is called the non-linear ckt.

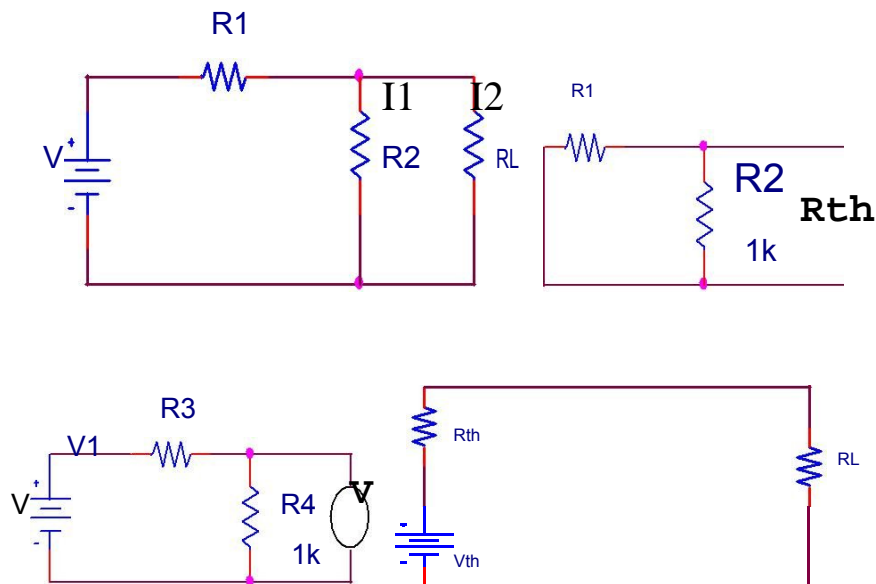
## EXPERIMENT NO. 2

**AIM:** TO VERIFY THEVENIN'S THEOREM.

**APPARATUS:** DC NETWORK KIT AND CONNECTING LEADS

**THEORY:** THEVENIN'S THEOREM as applied to the dc network ckt may be stated as the current flowing through a load resistance  $R_L$  connected across any two terminals A and B of a linear bilateral network is given by  $V_{TH} / R_{TH} + R_L$  where  $V_{TH}$  is the open ckt voltage and  $R_{TH}$  is the internal resistance of the network from terminal A to B with all voltage sources replaced with their internal resistances and current sources with infinite resistance.

### CIRCUIT DIAGRAM:



### PROCEDURE:

1. To find the current flowing through the load resistance  $R_L$  as shown in fig. remove  $R_L$  from the ckt temporarily and leave the terminals A and B open circuited.
2. Calculate the open ckt voltage  $V_{TH}$  which appears across terminal A and B.

$$V_{TH} = I \cdot R_{TH}$$

This is called Thevenin's voltage.

3. Now calculate  $R_{TH} = R_1 R_2 / (R_1 + R_2)$ . This is called Thevenin's resistance.
4. Calculate  $I_L = V_{TH} / (R_L + R_{TH})$ .
5.  $V_{TH} = E R_2 / (R_1 + R_2)$ .

## **OBSERVATION ELECTRICAL TECHNOLOGY (EE-103-F)**

**TABLE:**

SR.NO	APPLIED VOLTAGE (volts)	$V_{TH}$ (volts) Theo.	$V_{TH}$ (volts) Pract.	$R_{TH}$ (Ohms)	$I_L$ (mA) Pract.	$I_L$ (mA) Theo.	RESULT

**RESULT:** THEVENIN'S THEOREM has been verified.

**DISCUSSION:** In Thevenin's equivalent circuit Thevenin's equivalent voltage is in series with Thevenin's resistance and the load resistance.

**PRECAUTIONS:**

1. Switch off the supply when not in use.
2. Reading should be taken carefully.
3. All connections should be tight and correct.

**QUESTIONS/ANSWERS**

**Q.1** To what type of circuit Thevenin's theorem is applicable

**A.** Linear and bilateral

**Q.2** What is the use of Thevenin's theorem?

**A.** To convert the complex ckt into a voltage source and a series resistance

**Q.3** How  $R_{TH}$  is connected with the ckt?

**A.** In series

**Q.4** How is  $R_{TH}$  connected with the load resistance?

**A.** In series

**Q.5** What modification is done in galvanometer to convert it into a ammeter?

**A.** A large resistance in parallel

**Q.6** What modification is done in the galvanometer to convert it into a voltmeter?

**A.** A series resistance

**Q.7** Resistance is a n active element or the passive?

**A.** Passive

**Q.8** How will you calculate the  $R_{TH}$ ?

**A.** The resistance between the two terminals

**Q.9** In place of current source, what is placed while calculating  $R_{TH}$ ?

**A.** Replace current source by open ckt

**Q.10** In place of voltage source which electrical parameters is placed?

**A.** A short ckt.



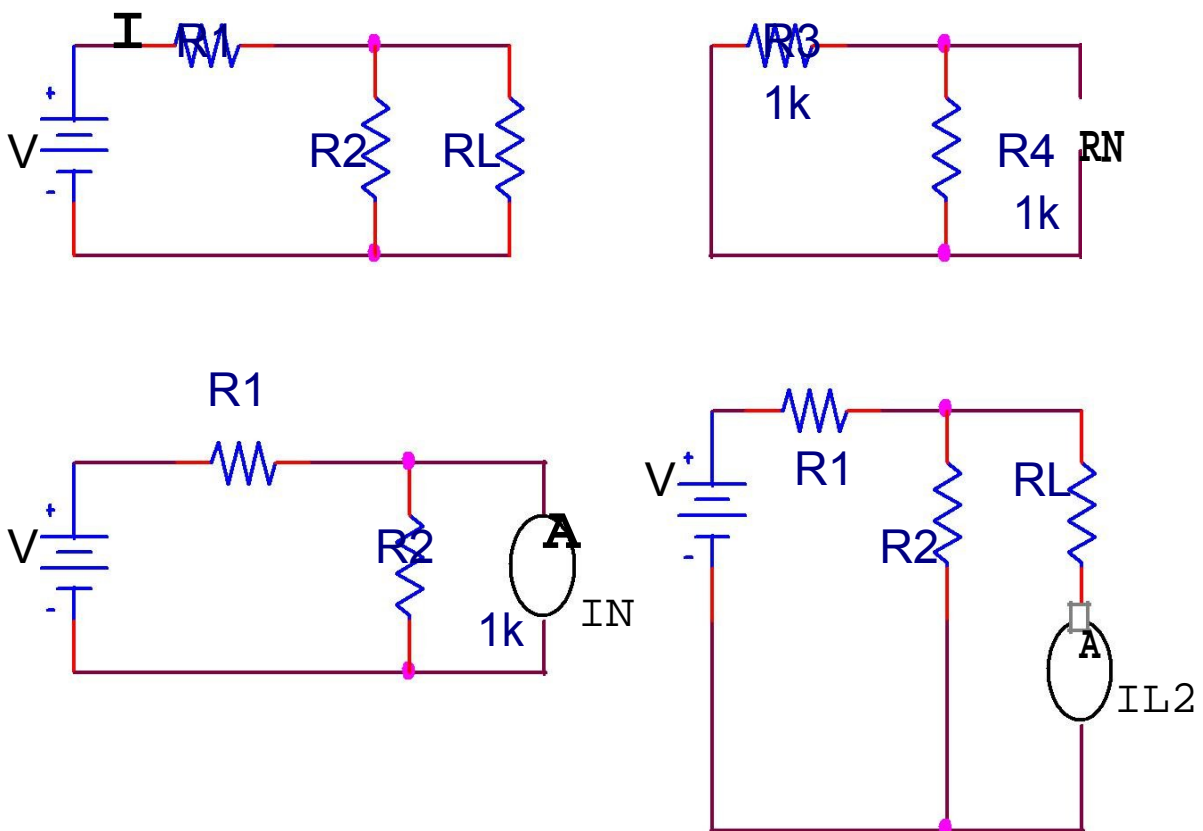
## EXPERIMENT NO 3

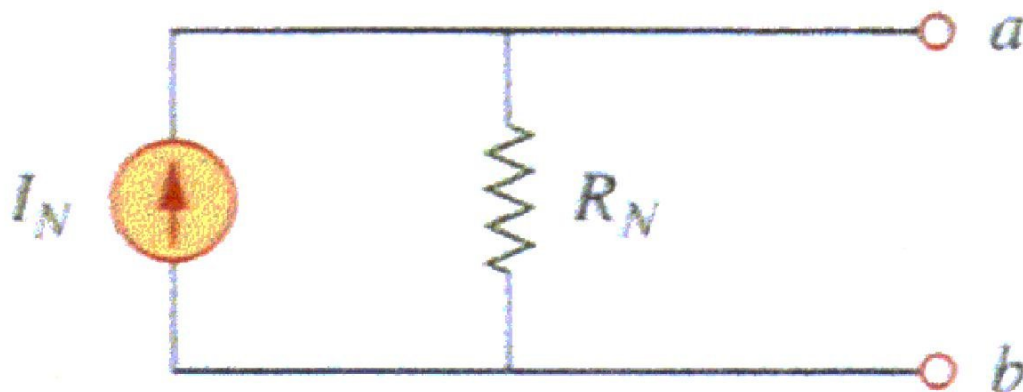
**AIM:** TO VERIFY NORTON'S THEOREM.

**APPARATUS:** DC NETWORK KIT, CONNECTING LEADS.

**THEORY:** Norton's theorem replaces the electrical network by an equivalent constant current source and a parallel resistance. Norton's equivalent resistance  $R_N = R_1 * R_2 / R_1 + R_2$  Actual load current in the circuit  $I_{L1}$  Theoretical load current  $I_{L2} = I_{SC} * R_N / (R_N + R_L)$ ,  $I_{SC}$  is the short circuit current.

**CIRCUIT DIAGRAM:**



**OBSERVATION TABLE:**

SR.NO.	APPLIED VOLTAGE (volts)	$I_N$ (mA)	$R_N$ ( $\Omega$ )	$I_{L1}$ (mA)	$I_{L2}$ (mA)	<u>ERROR</u> $I_{L1} - I_{L2}$	<u>RESULT</u>

**PROCEDURE :**

1. Connect the ckt as per the ckt diagram
2. Remove the load resistance
3. Find the Norton's resistance  $R_N$
4. Measure the Norton's current  $I_N$
5. Now measure the current in the load resistance directly
6. Find out the current in the load
7. Using formula find out the current in the load resistance
8. Verify that these two are equal.

**RESULT :** Norton's theorem is verified

**DISCUSSION:** In NORTON'S equivalent circuit the Norton's current source is in parallel with NORTON'S resistance and the load resistance.

**PRECAUTIONS:**

1. All connections should be tight and correct.
2. Switch off the supply when not in use.
3. Reading should be taken carefully.

## **QUESTIONS/ANSWERS:**

**Q.1** To what type of network Norton's theorem applicable?

**A.** Two terminal linear network containing independent voltage and current sources.

**Q.2** How is  $R_N$  connected to  $I_N$ ?

**A.** In the parallel

**Q.3** What is placed in place of voltage sources while calculating the  $R_N$ ?

**A.** Their internal resistance replaces these.

**Q.4** Give an example of unilateral ckt?

**A.** Diode rectifier

**Q.5** What is unilateral ckt?

**A.** Whose characteristics changes with the change in direction of operation

**Q.6** Give one example of the bilateral n/w?

**A.** Transmission lines

**Q.7** What is the limitation of Ohm's law?

**A.** Provided physical conditions do not change

**Q.8** What is the reason that ground pin are made of greater diameter in the plugs?

**A.**  $R = \rho L / A$

**Q.9** Where is the voltage divider rule applicable?

**A.** Two resistance in series

**Q.10** Where is the current divider rule applicable?

**A.** When there are two resistances in parallel.

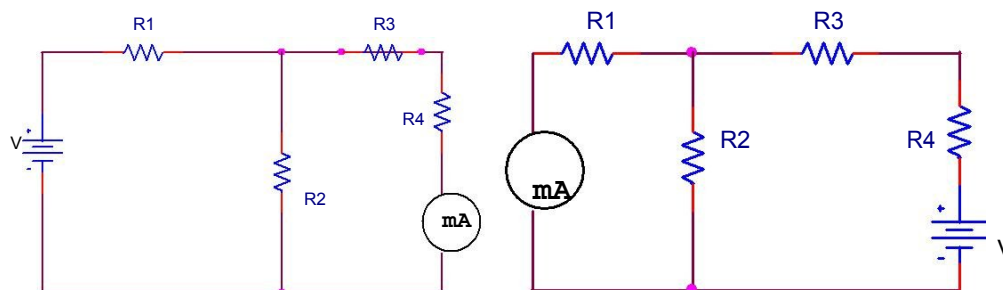
## EXPERIMENT NO 4

**AIM:** TO VERIFY RECIPROCITY THEOREM.

**APPARATUS:** DC NETWORK THEOREM KIT AND CONNECTING LEADS

**THEORY:** Reciprocity theorem can be stated as in any bilateral linear network if a source of emf  $E$  in any branch produces a current  $I$  in any other branch then the same emf  $E$  acting in the second branch will produce the same current  $I$  in the first branch.

**CIRCUIT DIAGRAM:**



**PROCEDURE:**

1. Make the connection according to the circuit diagram
2. Measure the value of current by ammeter
3. Interchange the position of the ammeter and the voltage source
4. Now again measure the value of current
5. Verify that  $I_1 = I_2$ .

**OBSERVATION TABLE:**

SR.NO	APPLIED VOLTAGE (volts)	$I_1$ (mA)	$I_2$ (mA)	ERROR $I_1 - I_2$

**RESULT :** Reciprocity theorem has been verified

**DISCUSSION:** In the bilateral linear network the position of voltage source and the ammeter can be interchanged, there will not be any change in their readings.

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## **PRECAUTIONS:**

1. Switch off the supply when not in use.
2. Reading should be taken carefully.
3. All connections should be tight and correct.

## **QUESTIONS/ANSWERS:**

**Q.1** To what type of the ckt, the reciprocity theorem applicable?

**A.** Linear and bilateral

**Q.2** What is transfer resistance in reciprocity theorem?

**A.**  $E/I$  = transfer resistance

**Q.3** Is reciprocity theorem applicable to ac?

**A.** Yes

**Q.4** What are mutually transferable in the reciprocity theorem?

**A.** E and I are mutually transferable

**Q.5** Is this theorem applicable to the ckt having capacitor or inductor?

**A.** No, it is applicable to only resistive ac ckt.

**Q.6** What is the frequency of mains?

**A.** 50 hz

**Q.8** What is the reference node in the ckt?

**A.** The reference node is the node with respect to which the potential at different points are calculated.

**Q.9** What is conventional current?

**A.** The current flowing from the positive to negative terminal of the battery is called the conventional current.

**Q.10** What is MCB?

**A.** Miniature ckt breaker

## EXPERIMENT NO. 5

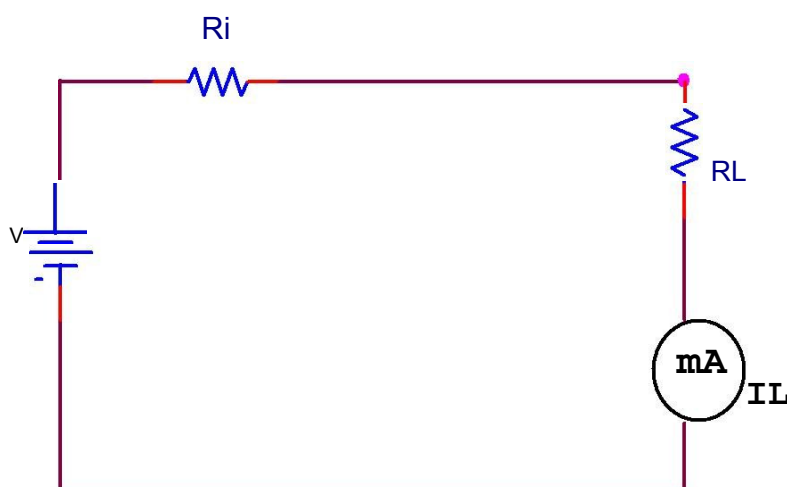
**AIM:** TO VERIFY MAXIMUM POWER TRANSFER THEOREM.

**APPARATUS:** DC NETWORK KIT AND CONNECTING WIRES

**THEORY:** The maximum power transfer theorem states that a load resistance will abstract maximum power from the network when the load resistance is equal to the internal resistance. For maximum power transfer Load resistance  $R_L = R_{in}$ , Where  $R_{in}$  internal resistance of the circuit.

Maximum power,  $P_{max} = V^2 / 4R_L$  Where V is the dc supply voltage.

### CIRCUIT DIAGRAM:



### PROCEDURE:

1. Connect the circuit diagram as shown in fig.
2. Take the readings of voltmeter and ammeter for different values of  $R_L$
3. Verify that power is maximum when  $R_L = R_I$

### OBSERVATION TABLE:

SR.NO.	APPLIED VOLTAGE (VOLTS)	$R_I$ ( $\Omega$ )	$R_L$ ( $\Omega$ )	$I_L$ (mA)	POWER = $I_L^2 \cdot R_L$ (mW)

**RESULT:** Maximum power transfer theorem has been verified.

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**DISCUSSION:** In the network maximum power is transferred when the load resistance is equal to the internal resistance of the network.

**PRECAUTIONS:**

1. Switch off the supply when not in use.
2. Reading should be taken carefully.
3. All connections should be tight and correct.

**QUESTIONS/ANSWERS:**

**Q.1** What is load matching?

**A.** The process of adjusting the load resistance for maximum power transfer is called load matching

**Q.2** What is max power transfer formula?

**A.**  $P_{\max} = E_{th}^2 / 4R_L$

**Q.3** What is the field of application of this theorem?

**A.** Motorcars, Telephone lines and TV aerial leads

**Q.4** What is electric network?

**A.** An electric ckt arises when a no. of parameters or electric elements coexist or combine in a certain arrangement.

**Q.5** What is necessary to know the polarity of voltage drop across a resistance? **A.** Direction of current through the resistance.

**Q.6** What is the reason that terminal voltage is less than emf?

**A.** Because there is some drop across the internal resistance.

**Q.7** What is the resistance of ideal voltage source?

**A.** Zero

**Q.8** When will the power extracted from a ckt is maximum?

**A.** When  $R_L$  is equal to the internal resistance of the ckt.

**Q.9** How is the ammeter connected in circuit?

**A.** In series

**Q.10** To find the voltage drop across a resistance, where should the voltmeter be connected?

**A.** In parallel.

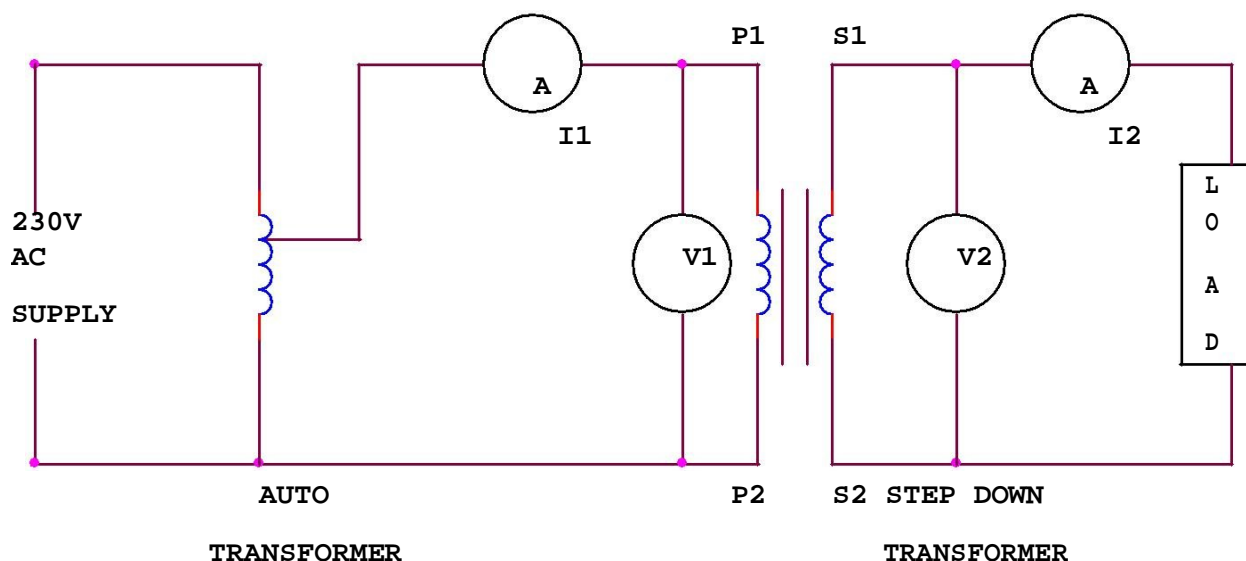
## EXPERIMENT NO 6

**AIM:** TO PERFORM THE DIRECT LOAD TEST ON THE TRANSFORMER AND PLOT THE CURVE BETWEEN EFFICIENCY AND VOLTAGE.

**APPARATUS:** AUTO TRANSFORMER, SINGLE PHASE DOUBLE WOUND TRANSFORMER, AMMETER, VOLTMETER.

**THEORY:** The ac voltage is applied to the primary coil, the ac current in the primary coil gives rise to flux change. The change of flux induces emf in the secondary coil due to mutual induction. We can calculate the efficiency by using voltmeter and ammeter since we are using resistive load.

### CIRCUIT DIAGRAM:



### PROCEDURE:

1. Connect the ckt as shown in fig.
2. Take the readings of  $I_1$  and  $V_1$  for primary
3. Take the readings of  $I_2$  and  $V_2$  for secondary
4. Calculate the efficiency of the transformer using the formula
5. Efficiency = output power / input power.

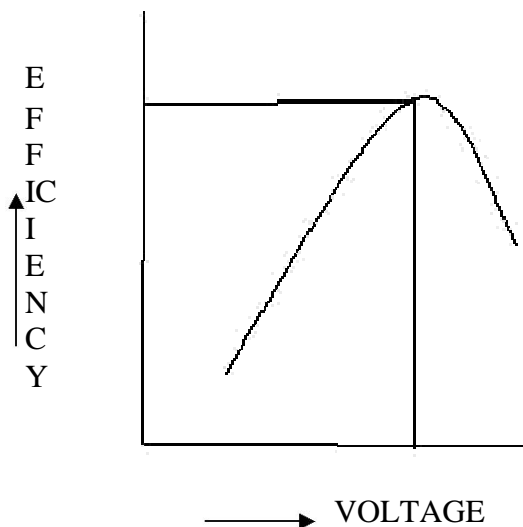
### OBSERVATION TABLE:

S.NO	$I_1$ (mA)	$V_1$ (volts)	$I_2$ (mA)	$V_2$ (volts)	EFFICIENCY = $V_2 I_2 / V_1 I_1$



**GRAPH:**

The efficiency increases with the increase in voltage and becomes maximum at a particular voltage and after that it decreases.

**RESULT :**

The efficiency of the single-phase transformer comes out to be.....

**DISCUSSION:** Mutual induction is the basic principle in the transformer. Direct load test is carried out to find out the efficiency of the transformer.

**PRECAUTIONS :**

1. All connections should be tight and correct.
2. Switch off the supply when not in use.
3. Reading should be taken carefully.

**QUESTIONS/ANSWERS:**

**Q.1** What is the effect on the frequency in the transformer?

**A.** No change

**Q.2** What is the medium for the energy conversion from the primary to secondary in the transformer?

**A.** By the flux.

**Q.3** What is the main reason for the generation of harmonics in the transformer?

**A.** Saturation of the core.

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**Q.4** Why are the ferrite cores used in the high frequency transformer?

**A.** High resistance

**Q.5** What type of winding is used in the 3-phase shell type transformer?

**A.** Sandwich type

**Q.6** What is increased in step up transformer?

**A.** Voltage

**Q.7** What is the effect on voltage in step down transformer?

**A.** Voltage is decreased

**Q.8** What is the formula of efficiency?

**A.** Output energy/input energy

**Q.9** What is the function of bushings in the transformer?

**A.** To make the external connections

**Q 10** What is the principal of transformer?

**A.** Mutual induction.

## **EXPERIMENT NO 7**

**AIM:** TO STUDY VOLTMETER, AMMETER, WATTMETER & MULTIMETER.

**THEORY:** There are different types of meters used in electrical ckt. which are explained below.

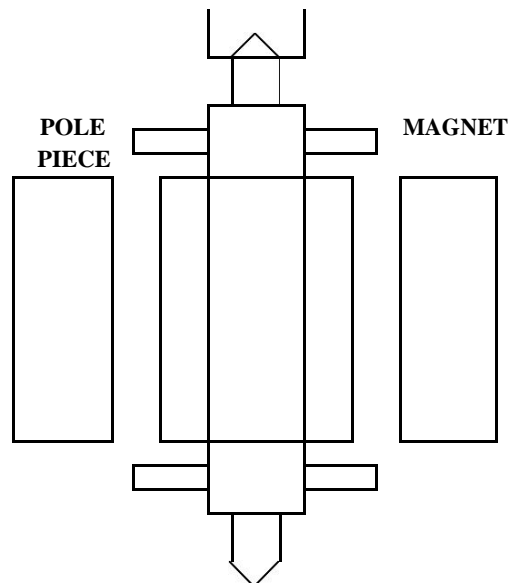
**Ammeters and voltmeters:** -

1. Moving iron type both for AC & DC.
2. Moving coil type for DC only.
3. Hot wire type both for AC & DC
4. Induction type for AC & DC.

**Wattmeters:**

1. Electrostatic type for AC & DC.
2. Dynamometer type both for AC & D
3. Induction type for AC only.
4. Electrodynamics type for DC only.

**DIAGRAM:-**



**2. Types of torques acting on different meters:** - There are three types of torques acting on different meters. Which are following.

- a) **Deflecting torque:** - This torque causes the moving system of the meter to move from

- b) **Controlling torque:** - This torque acts against the deflecting torque. It make the pointer of the meter to come to rest.
- c) **Damping torque:** - This torque helps to bring the pointer to rest quickly. Otherwise due to inertia the pointer will oscillate about its final deflecting position before coming to rest.

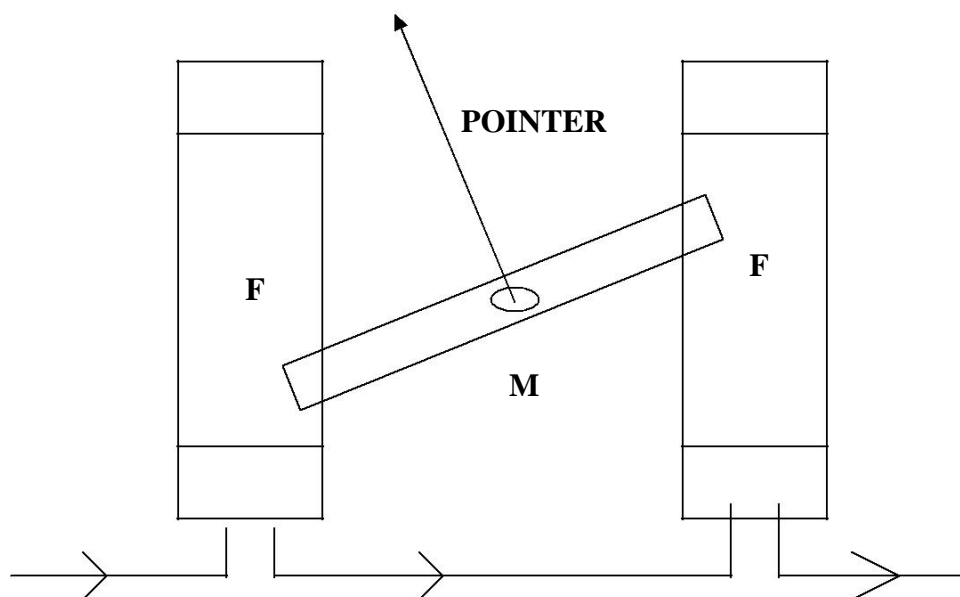
**Induction Wattmeter:** - It operates on the same principle on hich induction type ammeters & voltmeters operate. These instruments can be used only in AC system while dynamometer type wattmeter can be used in AC as well as DC system.

**Advantages & disadvantages of induction wattmeter:** - These watt meters posses the advantages of fairly long life. They are free from effects of stray fields. They have good damping. They are free from frequency errors. However they are subjected to some serious temperature errors because of the main effect of temperature on he resistance of eddy current path.

**Digital Multimeter:** - As the name suggests, it is a multi purpose instrument. It can measure AC & DC current, voltage, frequency, resistance. It can also test capacitors, diodes, PNP & NPN junctions. Its operation is also very simple. It gives very accurate value. It has no errors. I has many ranges which are following: -

1. DC range upto 100 V in 5 Ranges
2. AC range upto 750 V in 5 Ranges
3. DC Current ranges upto 10 A in 5 Ranges
4. AC Current ranges upto 10 A in 5 Ranges
5. Resistance upto 200M  $\Omega$  in 7 Ranges.

### **DIAGRAM:-**



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**RESULT:** The different measuring instruments have been studied.

**DISCUSSION:** Ammeters are used to measure the current but the moving coil type ammeter is used only for AC. Induction type wattmeter is used to measure the AC only, while the electro-dynamics type wattmeter is used for DC only.

**PRECAUTIONS:**

- 1 All connections should be tight and correct.
- 2 Switch off the supply when not in use.
- 3 Reading should be taken carefully.

**QUESTIONS /ANSWERS:**

**Q.1** What is the cheaper method of starting a 3-phase induction motor?

**A.** Direct over load starting

**Q.2** When a dc motor produces a max output power?

**A.** When back emf is equal to half of the applied voltage.

**Q.3** What is the use of wattmeter?

**A.** it is used to measure the power consumed in a ckt.

**Q.4** What are the different types of the wattmeter?

**A.** Dynamometer, induction and electrostatic

**Q.5** What is the use of integrating or the energy meter?

**A.** it is used to measure the quantity of electric energy supplied to the ckt in a given time.

**Q.6** What is a meggar?

**A.** These are the instruments which are used to measure the insulation resistance relative to earth.

**Q.7** What are the two types of the moving iron instruments?

**A.** Attraction type ,Repulsion type

**Q.8** What are the different types of the moving coil instruments?

**A.** Permanent magnet type ,Dynamometer type

**Q.9** What are the sources of error with the dc in moving iron instruments?

**A.** Error due to hysteresis, Error due to stray field

**Q.10** What are the errors with the ac in moving coil instruments?

**A.** Error due to hysteresis, Error due to stray field

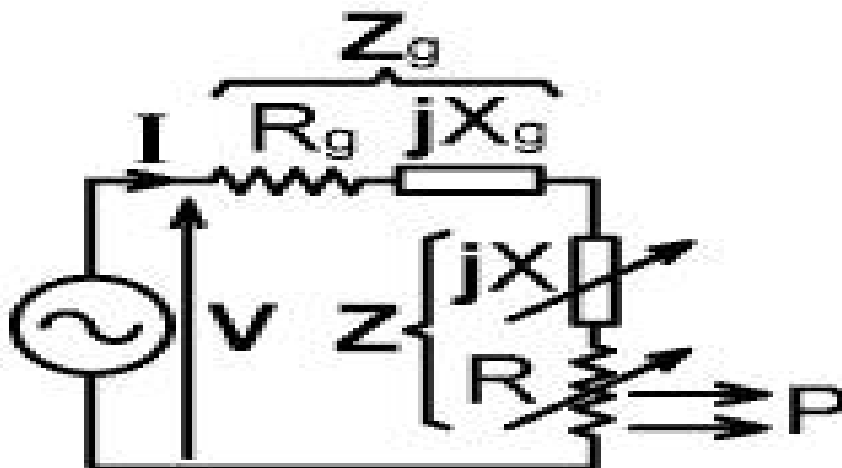
## EXPERIMENT - 8

**AIM :** TO VERIFY MAXIMUM POWER TRANSFER THEOREM IN A.C. CIRCUIT

**APPARATUS REQUIRED :-** AC NETWORK KIT AND CONNECTING WIRES

**THEORY:-** The power transferred to an impedance load will be maximum when load impedance is equal to the complex conjugate of the internal impedance of the source.

**CIRCUIT DIAGRAM:-**



**PROCEDURE:**

4. Connect the circuit diagram as shown in fig.
5. Take the readings of voltmeter and ammeter for different values of  $R_L$
6. Verify that power is maximum when load impedance is equal to internal impedance or in other words load resistance is equal to internal resistance.

**OBSERVATION TABLE:**

SR.NO.	APPLIED VOLTAGE (VOLTS)	$R_i$ ( $\Omega$ )	$R_L$ ( $\Omega$ )	$I_L$ (mA)	POWER= $I_L^2 \cdot R_L$ (mW)

**RESULT:** Maximum power transfer theorem has been verified.

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**DISCUSSION:** In the network maximum power is transferred when the load resistance is equal to the internal resistance of the network.

**PRECAUTIONS:**

1. Switch off the supply when not in use.
2. Reading should be taken carefully.
3. All connections should be tight and correct.

**QUESTIONS/ANSWERS:**

**Q.1** What is load matching?

**A.** The process of adjusting the load resistance for maximum power transfer is called load matching

**Q.2** What is max power transfer formula?

**A.**  $P_{\max} = V^2/4R_L$

**Q.3** What is the field of application of this theorem?

**A.** Motorcars ,Telephone lines and TV aerial leads

**Q.4** What is electric network?

**A.** An electric ckt arises when a no. of parameters or electric elements coexist or combine in a certain arrangement.

**Q.5** What is necessary to know the polarity of voltage drop across a resistance? **A.** Direction of current through the resistance.

**Q.6** What is the reason that terminal voltage is less than emf?

**A.** Because there is some drop across the internal resistance.

**Q.7** What is the resistance of ideal voltage source?

**A.** Zero

**Q.8** When will the power extracted from a ckt is maximum?

**A.** When load impedance is equal to internal impedance.

**Q.9** How is the ammeter connected in circuit?

**A.** In series

**Q.10** To find the voltage drop across a resistance, where should the voltmeter be connected?

**A.** In parallel.

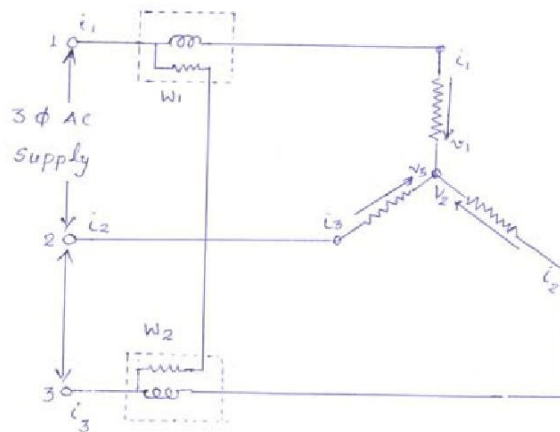
## EXPERIMENT-9

**AIM :-** MEASUREMENT OF POWER IN A THREE PHASE SYSTEM BY TWO WATTMETER METHOD

**APPARATUS REQUIRED :-** THREE PHASE VARIABLE LOAD, AMMETERS 0-10 A, MI, 2NOS, WATTMETERS 0-5 A, 300V, 2 NOS, VOLTMETER 0-300V, MI

**THEORY :-** Surprisingly, only two single phase wattmeters are sufficient to measure the total power consumed by a three phase balanced circuit. The two wattmeters are connected as shown in figure. The current coils are connected in series with two of the lines. The pressure (or voltage) coils of the two wattmeters are connected between that line and reference.

### CIRCUIT DIAGRAM :-



### PROCEDURE :-

1. Connect the circuit as shown in figure.
2. Keep the three phase variac at its zero position .
3. Switch on the main supply.
4. Increase the voltage supplied to the circuit by changing the positions of variac so that all the meters give readable deflection.
5. Note down readings of all the meters



**OBSERVATION TABLE:-**

Sr.No	V	I	W <sub>1</sub>	W <sub>2</sub>	P= W <sub>1</sub> + W <sub>2</sub>

**PRECAUTIONS :**

1. Connections should be tight.
2. Take the readings carefully.
3. Switch off the circuit when not in use.

**QUESTIONS/ANSWERS :-**

**Q.1.** How many coils are there in a single in a single phase wattmeter?

A. In general there are two coils in the wattmeter. One coil is known as current coil and other coil is known as pressure coil or voltage coil.

**Q.2.** What do you understand by phase sequence in reference to 3-phase circuits?

A. Phase sequence in three phase circuits means the order in which the phase voltages attain their respective maximum positive voltages.

**Q.3** What is the phase sequence of a 3-phase system in general?

A. The phase sequence of a three phase system is R, Y, B.

**Q.4** How the phase sequence of a three phase system can be changed?

A. If the connections of any two phases are interchanged, the phase sequence can be changed.

**Q.5** Is the method used in this experiment applicable to unbalanced loads?

A. Yes, we can use this method for unbalanced loads.

**Q.6** Can you measure reactive power in a three phase circuit using this method? A. Yes the reactive power is given by the relation.

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

**Q.7** Which type of wattmeter is generally used for measuring power in a.c. circuits? A.

Dynamometer type of instruments are generally used for measurement of power.

**Q.8** How a wattmeter is connected in an a.c. circuit?

A. There are four terminals in wattmeter. There are two coils in wattmeter one is current coil ( low resistance) in wattmeter and other is pressure coil (higher resistance).The current coil is always connected in series and pressure coil is connected in parallel.

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Q.9 What is the relation between line voltage and phase voltage in star connected system? A. Line voltage is equal to  $\sqrt{3}$  times of phase voltage.

Q.10 In a star connected 3-phase balanced load with neutral available, how many wattmeters are necessary to measure power?

A. Only one wattmeter is sufficient

## EXPERIMENT NO. 10

**AIM:** TO PERFORM THE OPEN CIRCUIT AND SHORT CIRCUIT TEST ON THREE PHASE INDUCTION MOTOR.

**APPARATUS :** M.I TYPE AMMETER, 0-10/20 A, M.I VOLTMETER 0-300/600V, DYNAMOMETER TYPE WATTMETER

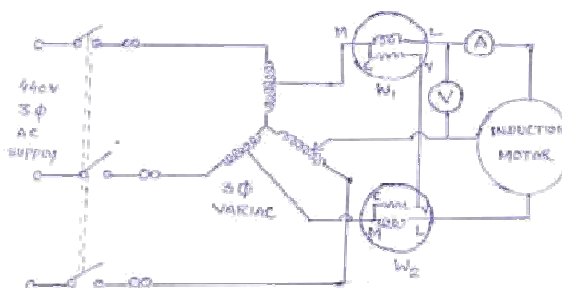
**THEORY:** For performing no-load or open circuit test, we supply the rated voltage to the induction motor, keep the motor running without mechanical load. The current drawn by the motor is quite low. The current drawn by the motor is very small. So the rating of the ammeter should be low. Further the ratings of the wattmeter should be rated voltage and low current. The readings of these instruments are taken. From the reading of wattmeters the total power consumed and power factor can be calculated. The readings can be recorded.

No-load current                =  $I_0$  A  
 Rated Voltage                =  $V_1$  V  
 Input power at no-load =  $W_0$  Watt

The short circuit test on induction motor can be conducted by using the same circuit diagram. However the instruments must be changed. In the short circuit test the motor is prevented from rotation either by holding the motor by hand or by using friction pulley. A reduced voltage is applied to the stator of the motor through a three phase-variatic. The magnitude of voltage applied should be sufficient to allow the rated current,  $I_1$  to flow through the circuit. The readings can be recorded as

Voltage applied =  $V_s$  V  
 Current taken =  $I_s$  A  
 Power taken =  $W_s$  watt

### CIRCUIT DIAGRAM:



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**PRECAUTIONS** :

1. All the connections should be neat and tight.
2. The range of instruments in both the tests should be carefully selected
3. Switch off the circuit when not in use.

**CONCLUSION**: The No load or open circuit test and block rotor or short circuit tests can be used for parameter findings of equivalent circuit.

**QUESTIONS/ANSWERS** :

Q.1 How do you obtain a reduced voltage from the 3-phase supply?

A. Reduced voltage from a 3-phase supply is obtained by using a 3-phase variac.

Q.2 What is the output of the 3-phase induction motor working under blocked-rotor conditions?

A. The output of the 3-phase induction motor working under blocked-rotor conditions is zero.

Q.3 What is the output of 3-phase induction motor working under no-load conditions?

A. The output of 3-phase induction motor working under no-load conditions is zero.

Q.4 How much voltage is induced in the rotor circuit under no-load conditions?

A. The slip under no-load conditions is quite low and therefore the rotor induced emf is quite low.

Q.5 Why the power factor of three phase induction motor under no-load conditions is quite low?

A. The magnetizing component of no-load current is quite high as compared to the active component of the no-load current. Due to this fact the no-load power factor is low.

Q.6 What approximate fraction of rated current is the no-load current for a three phase induction motor?

A. No-load current is approximately 30% of the rated current.

Q.7 For performing the blocked-rotor test on a three phase induction motor. How much voltage applied to the stator of the motor?

A. A reduced voltage of the order of 25% of the rated value is applied through variac for performing the blocked rotor test on a three phase induction motor.

Q.8 How does the no-load current drawn by the three phase induction motor compares with the no-load current drawn by a transformer? Why?

A. The no-load current drawn by the 3-phase induction motor is comparatively higher than the no-load current drawn by a transformer of equal rating. There is no air gap in transformer. In case of an induction motor there is an air gap. Ampere turns are required to overcome the reluctance of the air gap in induction motor is quite high. It is approximately 70% of the total ampere turns. This fact accounts for a comparatively larger no-load current.

Q.9 If the rotor windings of a wound rotor are kept open, can we perform the blocked-rotor test on this machine.

A. No, because as long as the rotor circuit is open, no e.m.f can be induced in the rotor.

Q.10 What is the power factor of a 3-phase induction motor operating under blocked-rotor condition?

A. It is quite low i.e of the order of 0.3 lagging.

