Bhatiya Institute Engineering & Technology Sikar

ELECTRICAL MEASUREMENT & INSTRUMENTATION

LAB MANUAL
OF
ELECTRONIC MEASUREMNT
&
INSTRUMENTATION

DO'S

- Maintain strict discipline.
- Proper handling of apparatus must be done.
- Before switching on the power supply get it checked by the lecturer.
- Switch off your mobile.
- Be a keen observer while performing the experiment

DONT'S

- Do not touch or attempt to touch the mains power directly with bare hands.
- Do not manipulate the experiment results.
- Do not overcrowd the tables.
- Do not tamper with equipment's.
- Do not leave the lab without prior permission from the teacher.

INSTRUCTIONS TO THE STUDENTS

GENERAL INSTRUCTIONS

- Maintain separate observation copy for each laboratory.
- Observations or readings should be taken only in the observation copy.
- Get the readings counter signed by the faculty after the completion of the experiment.
- Maintain Index column in the observation copy and get the signature of the faculty before leaving the lab.

BEFORE ENTERING THE LAB

- The previous experiment should have been written in the practical file, without which the students will not be allowed to enter the lab.
- The students should have written the experiment in the observation copy that they are supposed to perform in the lab.
- The experiment written in the observation copy should have aim, apparatus required, circuit diagram/algorithm, blank observation table (if any), formula (if any), programme (if any), model graph (if any) and space for result.

WHEN WORKING IN THE LAB

- Necessary equipment's/apparatus should be taken only from the lab assistant by making an issuing slip, which would contain name of the experiment, names of batch members and apparatus or components required.
- Never switch on the power supply before getting the permission from the faculty.

BEFORE LEAVING THE LAB

- The equipments/components should be returned back to the lab assistant in good condition after the completion of the experiment.
- The students should get the signature from the faculty in the observation copy.

They should also check whether their file is checked and counter signed in the index.

LIST OF EXPERIMENTS

1. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) CROProbes.

2. Study working and applications of Meggar, Tong-tester, P.F. Meter and Phase Shifter.

3. Measure power and power factor in 3-phase load by (i) Two-wattmeter method and (ii) One wattmeter method.

4. Calibrate an ammeter using DC slide wire potentiometer.

5. Calibrate a voltmeter using Crompton potentiometer.

6. Measure low resistance by Crompton potentiometer.

7. Measure Low resistance by Kelvin's double bridge.

8. Measure earth resistance using fall of potential method.

9. Calibrate a single-phase energy meter by phantom loading at different power factors.

10. Measure self-inductance using Anderson's bridge.

11. Measure capacitance using De Sauty Bridge

EXPERIMENT NO: 01

OBJECT:

To study, working and application of
(1)C.R.O
(2)Digital storage C.R.O
(3)CRO Probes

APPARATUS REQUIRED:

Function generator, cathode ray oscilloscope, CRO probes.

THEORY:

The CRO is very useful and versatile Laboratory instrument used for display measurement and analysis of waveform. CRO operator on voltage, however it Is possible to convert current strain, acceleration, pressure, and other physical quantities into voltage with the help of transducers.

CRO are used to invertage waveform, transient phenomenon and other time ray varying quantities from a very low frequency to the radio frequency.

CRT:

A cathode ray oscilloscope consists of a cathode ray tube (CRT) which is the of the tube and some additional circuit to operate the CRT

The main part of CRT is:

(1)Electron gun
(2)Deflection gun
(3) Florescent screen
(4)Glass envelope
(5)Base through which connection are made to various

1. **Electron Gun**:

It assembly produces a sharply focused beam of electron which to high velocity
This focused beam of the electron strikes the fluorescent screen with sufficient energy to cause luminous.

2. **Digital storage oscilloscope:**

It digits the input signal so that all sub requires the CRT is used and storage occurs in electronic digital memory.

3. **Fluorescent screen:**

The front of the CRT is called the face plate. It is a plate screen size up to about

100mm*100mm and is slightly curved for large display inside the surface of the plate is coated with phosphor.

4**. Envelope**:
Glass envelope is a grid of lines that server as scale when making time and amplitude measurement

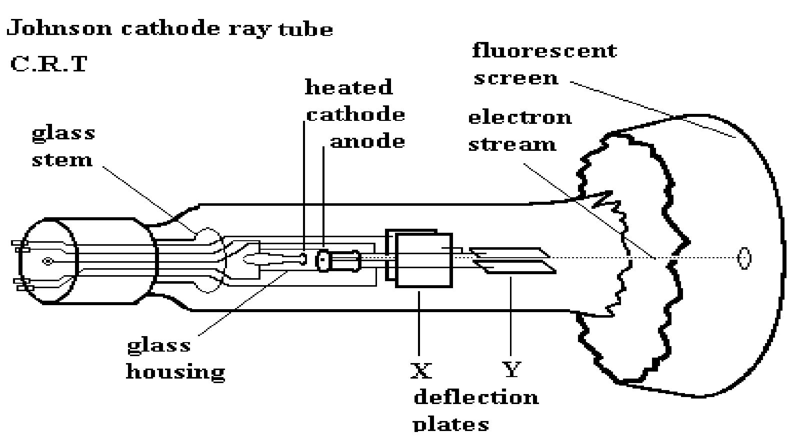
5. **Base**
Through which connection are made to various ports: If the wave form is to be accurately reproduced the beam must have a constant horizontal velocity
The beam velocity is a function of the deflecting voltage , the deflecting voltage must increase linearly with time
A voltage with this characteristic is called ramp voltage.

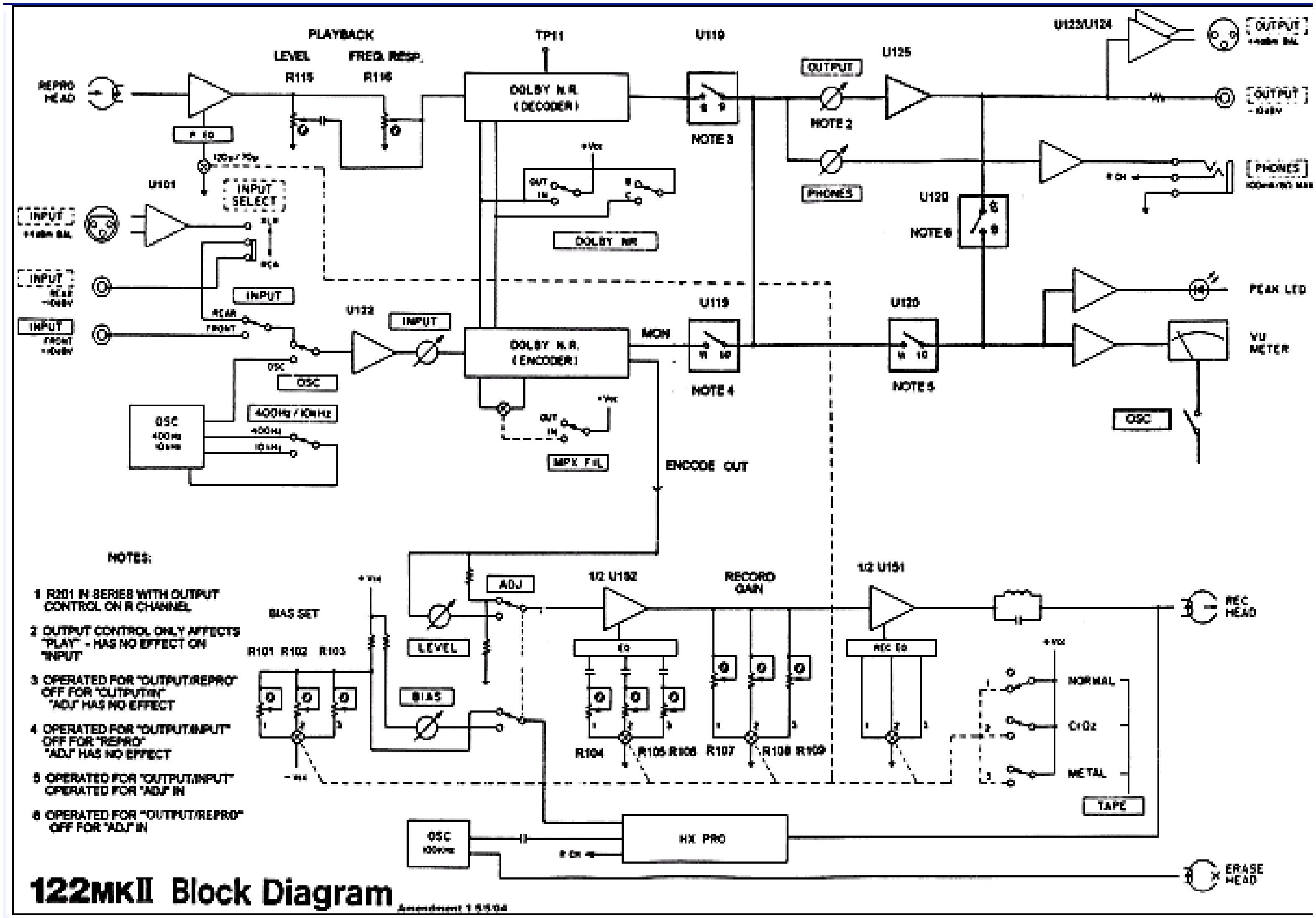
Advantage:

1. The storage oscilloscope has a CRT which is much cheaper then is analogue storage.
2. It is capable of an infinite storage time using its digital memory.

Probes:
The probe pattern is very important of connecting the test circuit to the oscilloscope without attracting

CIRCUIT DIAGRAM:-





NOTES:

1 R201 IN SERIES WITH OUTPUT CONTROL ON R CHANNEL
2 OUTPUT CONTROL ONLY AFFECTS "PLAY" - HAS NO EFFECT ON "INPUT"
3 OPERATED FOR "OUTPUT/REPRO" OFF FOR "OUTPUT/IN" "ADJ" HAS NO EFFECT
4 OPERATED FOR "OUTPUT/INPUT" OFF FOR "REPRO" "ADJ" HAS NO EFFECT
5 OPERATED FOR "OUTPUT/INPUT" OPERATED FOR "ADJ" IN
6 OPERATED FOR "OUTPUT/REPRO" OFF FOR "ADJ" IN

122MKII Block Diagram

OBESERVATION TABLE:

S.NO.	AMPLITUDE READING		FREQUENCY READING	
	THEORITICAL	PRACTICAL	THEROTICAL	PRACTICAL

Result : CRO, CRO probes and digital CRO studied.

Precaution:

1. Measure or take the reading properly & carefully.
2. Multiplying factor should be multiplied is the calculation.
3. Wave should be placed carefully on the origin.

EXPERIMENT No. 02

Object: Study working and applications of

- Megger,
- Tong-Tester,
- P.F. Meter
- Phase Shifter.

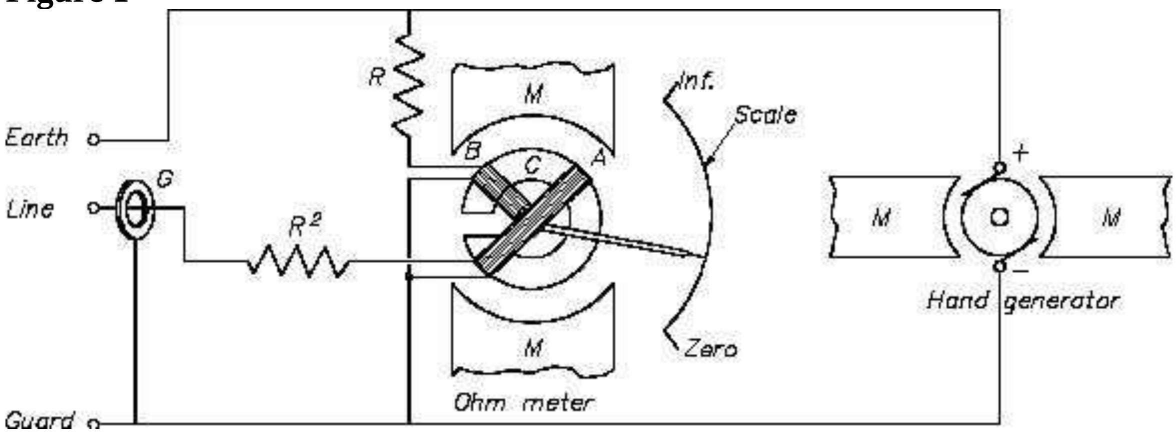
Theory:

- Megger has become the generic description for a high voltage, low currentinsulation tester. The word is short for mega ohm-meter. Although any Ohmmeter or Multi-meter may appear capable of similar measurements, only a Megger type instrument can test the quality of the insulation at orabove its operating voltage.
- Choice of test voltage is normally determined by the operating voltage of the circuit under test; usually twice the operating voltage is sufficient. Two basic insulation tests are possible: Insulation to ground and insulation between conductors.

How Insulation Resistance is measured:

- Good insulation has high resistance; poor insulation, relatively low resistance. The actual resistance values can be higher or lower, depending upon such factors as the temperature or moisture content of the insulation(resistance decreases in temperature or moisture).
- Megger insulation tester measures insulation resistance directly in ohms or meg-ohms. For good insulation, the resistance usually reads in the meg-ohm range. The Megger insulation tester is essentially a high-range resistance meter (ohmmeter) with a built-in direct-current generator.
- This meter is of special construction with both current and voltage coils, enabling true ohms to be read directly, independent of the actual voltage applied. This method is Non -destructive; that is, it does not cause deterioration of the insulation.

Figure 1–



Typical Megger test instrument hook-up to measure insulation resistance. The generator can be hand-cranked or line-operated to develop a high DC voltage which causes a small current through and over surfaces of the insulation being tested (Fig. 1). This current (usually at an applied voltage of 500 volts or more) is measured by the ohmmeter, which has an indicating scale. Fig. 2 shows a typical scale, which reads increasing resistance values from left up to infinity, or a resistance too high to be measured.

Fig.2. Typical scale on the Megger insulation tester .Factors affecting insulation resistance readings:

1. Capacitance Charging Current
   Current that starts out high and drops after the insulation has been charged to full voltage (much like water flow in a garden hose when you first turn on the spigot).

2. Absorption Current

3. Conduction or Leakage Current
   A small essentially steady current both through and over the insulation.

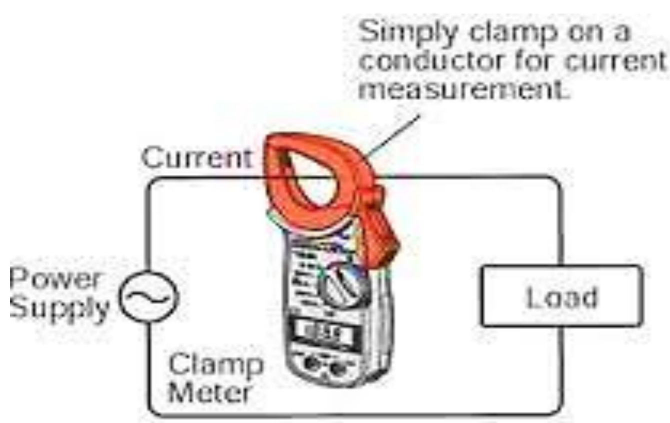
Tong-Tester:

In electrical and electronic engineering, a current clamp or current probe is an electrical device having two jaws which open to allow clamping around an electrical conductor. This allows the electrical current in the conductor to be measured, without having to make physical contact with it, or to disconnect it for insertion through the probe. Some types of current clamp are used to induce current in the conductor. Tong -tester also called current clamper.

Features of Tong Tester

* 3 1/2", 4 1/2" digit multimeter
* Resistance/ Voltage/Current
* Transistor / Diode / Capacitance /Frequency.
* DMM with Graphic LCD, RS-232 for PC
* Connection
* Current/Voltage/Resistance/Temp.
* Diode check, data hold, peak hold

Fig-3



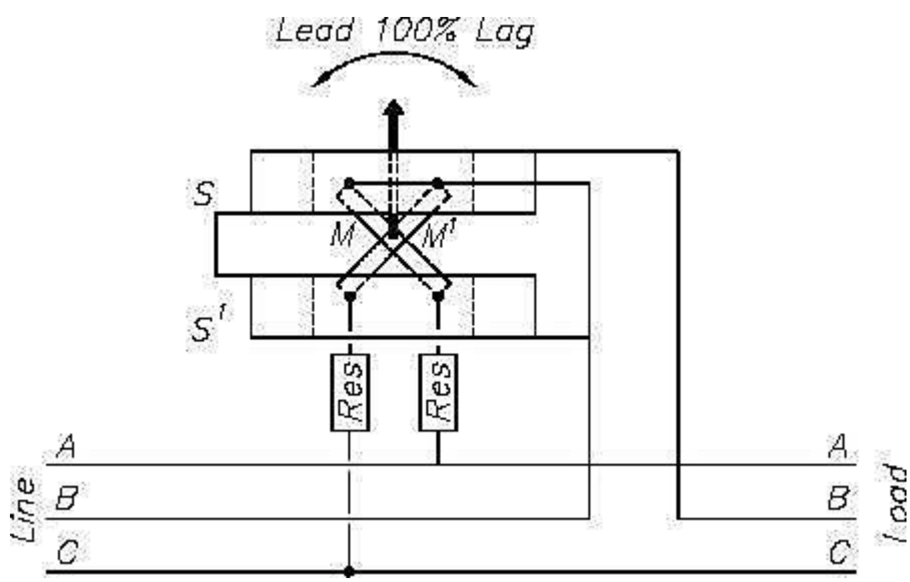
POWER FACTOR METER:

➢ The single-phase meter contains a fixed coil that carries the load current, and crossed coils that are connected to the load voltage. There is no spring to restrain the moving system, which takes a position to indicate the angle between the current and voltage. The scale can be marked in degrees or in power factor.

- The angle between the currents in the crossed coils is a function of frequency, and consequently each power-factor meter is designed for a single frequency and will be in error at all other frequencies.
- A power factor meter is a type of electrodynamometer movement when it is made with two movable coils set at right angles to each other. The method of connection of this type of power factor meter, in a 3f circuit.
- The two stationary coils, S and S1, are connected in series in Phase B. Coils M and M1 are mounted on a common shaft, which is free to move without restraint or control springs. These coils are connected with their series resistors from Phase B to Phase A and from Phase B to Phase C.

At a power factor of unity, one potential coil current leads and one lags the current in Phase B by 30°; thus, the coils are balanced in the position shown in Figure 4.

Fig.4.



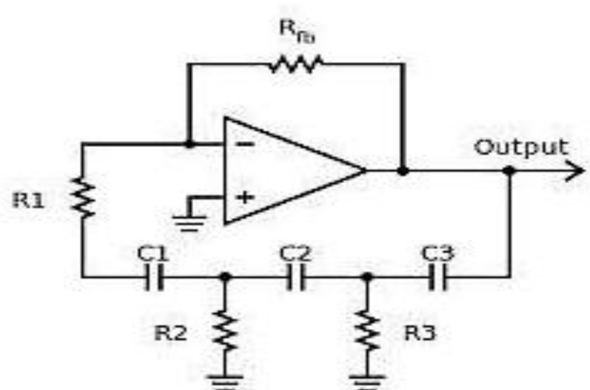
PHASE SHIFTER:

A phase shifter is a microwave network which provides a controllable phase shift of the RF signal.

- Phase Shifters are devices, in which the phase of an electromagnetic wave of a given frequency can be shifted when propagating through a transmission line. In many fields of electronics, it is often necessary to change the phase of signals. RF and microwave Phase Shifters have many applications in various equipments such as phase discriminators, beam forming networks, power dividers, linearization of power amplifiers, and phase array antennas.

The major parameters which define the RF and microwave Phase Shifters are:
· Frequency range,
· Bandwidth (BW),
· Total phase variance (Δj),
· Insertion loss (IL),
· Switching speed,
· Power handling (P),
· Accuracy and resolution,
· Input/output matching (VSWR) or return loss (RL),

Fig.5



Result:

We have successfully studied the working and applications of Megger, Tong-Tester, P.F. Meter, Phase shifter.

EXPERIMENT NO.3

OBJECT:- Measure the power in 3- phase star connected load by two wattmeter method at different values of load power factor.

APPARATUS REQUIRED:-

1. Voltmeter (0-150/300/600 V) - 3 Nos.
2. Ammeter (0 – 5/10 A) – 3 Nos.
3. Wattmeter (0 – 300 V) 5 amps UPF – 2 Nos.
4. 3 – phase resistive load – 1
5. 3 phase auto transformer
6. Connecting wires

THEORY:-

The three phase, three wire systems:

Two wattmeter method:

(i) Star connected balanced load

Assuming the phase sequence to be RYB, the phase voltages are VRN, VYN and VBN. Let the phase angle between the phase voltage and phase current be Φ degree. If the load is assumed to be inductive in nature then current in each phase lags the phase voltage by Φ degrees.

From the circuit diagram

$V_{RY} = V_{RN} - V_{YN}$

$V_{RY} = V_{BN} - V_{YN}$

Taking V_{RN} as reference voltage,

Wattmeter reading

$$W_1 = V_{BY} I_B \cos(30 - \Phi)$$

Wattmeter reading $W_2 = V_{RY} I_R \cos(30 + \Phi)$

$$\text{Total power} = W = W_1 + W_2$$
$$= V_{BY} . I_B \cos(30 - \Phi) + V_{RY} I_R \cos(30 + \Phi)$$

But

$V_{BY} = V_{RY} = V_L$ and $I_B = I_R = I_L$

$$W = V_L I_L \cos(30 - \Phi) + V_L I_L \cos(30 + \Phi)$$

$$= V_L I_L [\cos(30 - \Phi) + \cos(30 + \Phi)]$$

$$= V_L I_L [\cos 30 . \cos\Phi + \sin 30 . \sin\Phi + \cos 30 \cos\Phi - \sin 30 . \sin\Phi]$$

$$= V_L I_L 2 \cos 30 \cos\Phi$$

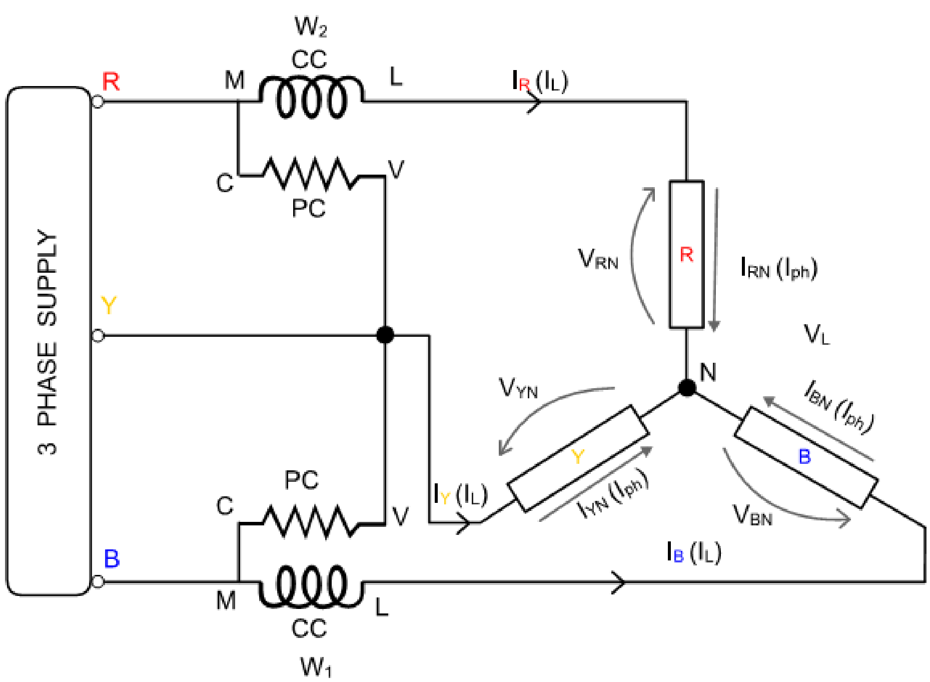
$$= V_L I_L 2 \times \sqrt{3} / 2 . \cos\Phi$$

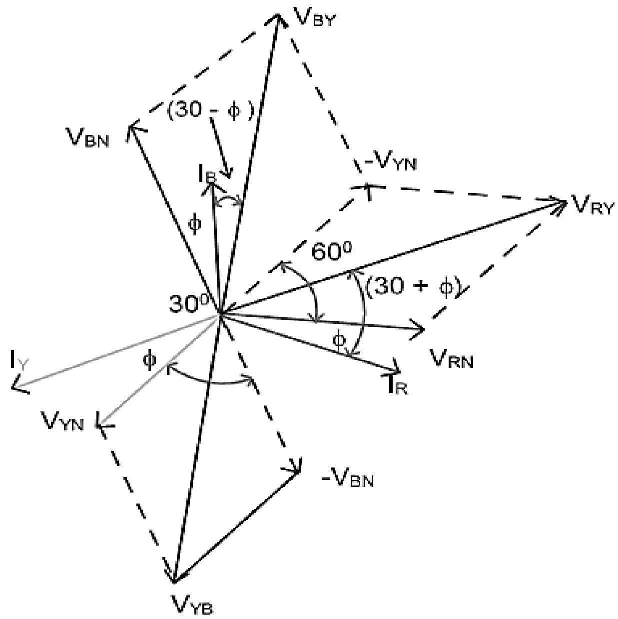
$$W = \sqrt{3} . V_L I_L \cos\Phi \text{ watts}$$

This shows that two wattmeter is sufficient to measure total power in a 3 phase star system

Circuit diagram:

-





Observation table:-

For R Load

S.no	V_1 volts	V_2 volts	I_1 amp	I_2amp	I_3 amp	P_1 watts	P_2 watts	P watts

For R-L Load

S.no	**V_1 volts**	**V_2 volts**	**I_1 amp**	**I_2amp**	**I_3 amp**	**P_1 watts**	**P_2 watts**	**P watts**

Result:- Total measurement with the help of two wattmeters has been shown in the above table.

EXPERIMENT NO.4

OBJECT: - Calibration of ammeter using Portable (D.C slide wire) Potentiometer.

APPARATUS REQUIRED:-

1. Portable Potentiometer
2. D.C power supply (2V/5Amp, 5V/5Amp) 2 No.
3. Ammeter (0-5Amp)
4. Shunt (75mA)
5. Rheostat (0-50 ohms, 2.4A)

BRIEF THEORY:-

Potentiometer is an instrument for measuring an unknown emf or potential difference by balancing it, wholly or in part, by a known current in a network of a circuit of known characteristics.

OR

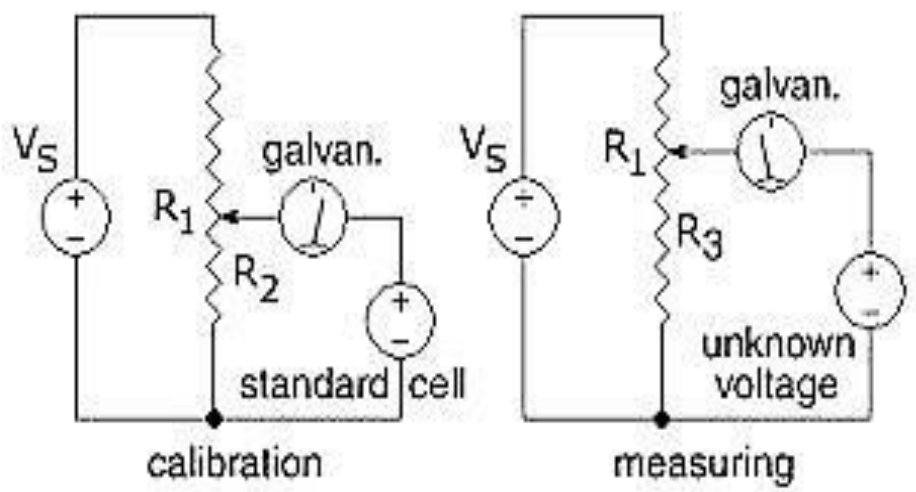
A potentiometer is an instrument design to measure an unknown voltage by comparing it with known voltage. Potentiometer is extensively used in measurement where the precision required is higher than what it could be obtained by deflection measurement.

- It is important that no current be drawn from the source under measurement. This current must be limited to a small value.
- Electromotive force is measured directly with a potentiometer in terms of the emf of a standard cell. By using in addition, a standard resistance (shunt) current can also be measured, from potentiometric measurement of current and voltage, power can be calculated. The potentiometer is thus one of the most fundamental of electrical measurements.

CALIBRATION OF AMMETER:-

As it is known that Potentiometer can only measure voltage, therefore current should be made readable in term of calibration ammeter .For this current is allowed to pass through four terminal slow resistance and voltage across it is measured with the help of potentiometer thereby determining current as I=V/R.

CIRCUIT DIAGRAM:-



PROCEDURE:-

1. Make the connection as shown in figure
2. Switch on the battery of portable Potentiometer
3. Operate STANDARDIZE key repeatedly and adjust coarse and fine controls until galvanometer gives no deflection.
4. Adjust the current through ammeter and determine the potential across resistance with the help of potentiometer (by operating Test key).
5. Repeat the above step and take 8 to 10 observations

OBSERVATION TABLE:-

S.No.	Ammeter reading in amps (I)	Potentiometer readings in volts (V)	I'=V/R amp	Percentage error = (I'-I)/I×100

RESULT: - Plot the graph between ammeter reading and percentage error.

EXPERIMENT NO. 5

OBJECT: - Calibration of voltmeter using Crompton Potentiometer

APPARATUS REQUIRED:-

(1) Crompton Potentiometer
(2) D.C. Power supply(0 - 5V, 5A)
(3) Constant Voltage Source (2V)
(4) Rheostat (45 Ohms 4.2 A)
(5) Super Sensitive Galvanometer
(6) Voltage Ratio Box
(7) Voltmeter To Be Calibrated (0 – 15 V)
(8) Standard Cell (1.0186V)

THEORY:-

Potentiometer is an instrument for measuring an unknown emf or potential difference by balancing it, wholly or in part, by a known current in a network of a circuit of known characteristics.

OR

A potentiometer is an instrument design to measure an unknown voltage by comparing it with known voltage. Potentiometer is extensively used in measurement where the precision required is higher than what it could be obtained by deflection measurement.

- It is important that no current be drawn from the source under measurement. This current must be limited to a small value.
- Electromotive force is measured directly with a potentiometer in terms of the emf of a standard cell. By using in addition, a standard resistance (shunt) current can also be measured, from potentiometric measurement of current and voltage, power can be calculated. The potentiometer is thus one of the most fundamental of electrical measurements.

CALIBRATION OF VOLTMETER:-

- The battery in the primary circuit of the potentiometer provides the working current. The potentiometer is standardized by the help of the standard cell. By that voltage at any point is proportional to the length of the slide wire.
- Now calibration of voltmeter can be performed. A stable D.C. source supply is required to have correct calibration of voltmeter. A voltage ratio box is used to step-

down the voltage to be calibrated so that potentiometer can measure the voltage near its maximum range and give desired calibration of voltmeter.

SUB ASSEMBLY:-

1. **Potential Terminal** – External measuring circuit can be connected to the terminal marked 'TEST'. Due care should be taken for the polarity of the external circuit. Positive should be connected to the positive (red) terminal and the negative to negative (Black) terminal of the potentiometer.

2. **Standard Cell Terminals** – Standard cell is to be connected to the terminals marked 'STANDARD CELL' taking care of the proper polarity.

3. **GALVANOMETER Terminals -** Two terminals marked 'GALVANOMETER' are meant for galvanometer. A sensitive galvanometer should be used.

4. **Battery Terminals** – Two terminals marked '2 VOLTS'. While connecting the battery, care should be taken of the proper polarity of the terminals.

5. **Press keys** – Press key marked 'TEST' is to be used to test the unknown potential. Press key, marked 'STANDARDISE' is to be used to standardise the potentiometer.

6. **Rheostat Dials** – Two dials marked 'COARSE' and FINE are to control the current in the battery circuit.

7. **Potential Dials** – This potentiometer has two measuring dials-
   (1) Main dial has 6 steps, each of 0.25 volts.
   (2) Slide wire dial is calibrated from 0 to 250 millivolts. Each millivolt is subdivided in 2 parts. Thus each division corresponds to 0.0005 volts.

ACCESSORIES:-

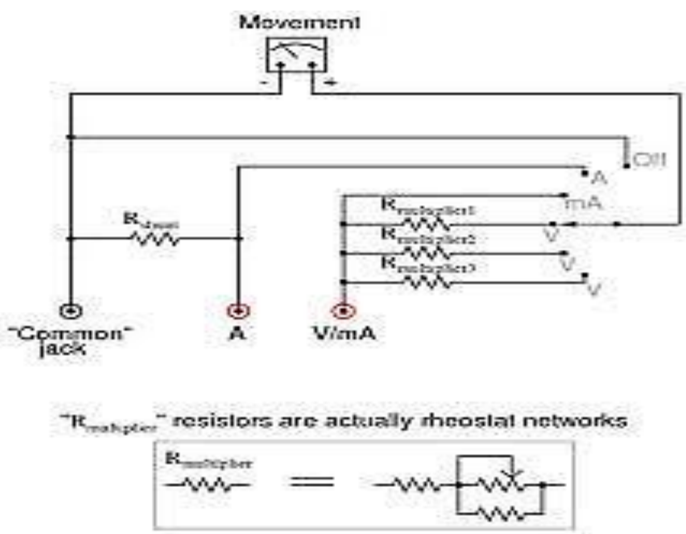
BATTERY-A Secondary cell or battery which can give 2 volts supply to the potentiometer is required. This should be able to give constant current throughout the experiment.

STANDARD CELL-In all measurement of emf with the potentiometer, it is necessary to have a known emf that can be used to standardize the value of the current through the potentiometer. Such a known emf is furnished by a standard cell.
Standard cell is used as a standard of emf and is never expected to furnish a current.

GALVANOMETER - The function of a galvanometer in connection with a potentiometer is that of an indicator of absence of current and consequently of absence of potential difference at its terminals. It is essential, therefore, that it should respond readily by a deflection when a slight potential difference exists.

VOLT RATIO BOX - Volt Ratio Box is used to increase the range of the Crompton Potentiometer beyond 1.75 volts. The volts ratio box is a particular from of potential divider connected to the large voltage to be measured. A definite fraction if this voltage is then measured by the potentiometer.

CIRCUIT DIAGRAM:-



PROCEDURE:-

(1) Make the connection as per the circuit diagrams.
(2) Switch ‘ON’ the supply of potentiometer.
(3) Standardize the potentiometer by connecting the standard cell to standard terminals. Press the standard key and vary the fine and coarse knob to indicate zero deflection in galvanometer.

(4) After standardization, connect the voltage ratio box terminals to test terminals.
(5) Now press the ‘Test’ key and vary the voltage knob so as to have null deflection in galvanometer.
(6) Note down the voltage as indicated by voltage knob (both volts and millivolts).
(7) Repeat the experiment for different values of D.C. supply voltage.
(8) Compare the voltage reading and potentiometer readings.
(9) Switch ‘OFF’ the supply.

OBSERVATION TABLE:-

S.No.	**Voltmeter reading in volts (V)**	**Potentiometer readings in volts (V’)**	**Percentage error = (V’-V)/V×100**

Calculation/Graph (if any):-

RESULT: - Plot the graph between voltmeter reading and percentage error.

EXPERIMENT NO. 6

OBJECT: - To measure low resistance using Crompton's potentiometer.

APPARATUS REQUIRED:-

(1) Crompton Potentiometer
(2) D.C. power supply
(3) DPDT switch in box
(4) Standard cell
(5) Ammeter
(6) Standard resistance (S)
(7) Unknown resistance (R)
(8) Constant voltage source
(9) Supersensitive galvanometer

BRIEF THEORY:-

For measurement of resistance with the help of potentiometer the unknown resistance R is connected in series with the standard resistance S. known value of current is allowed to flow through the series combination. Then voltage across R and S are measured as V_R and V_S respectively with the help of potentiometer.

From circuit

$V_R = IR$………. (1)

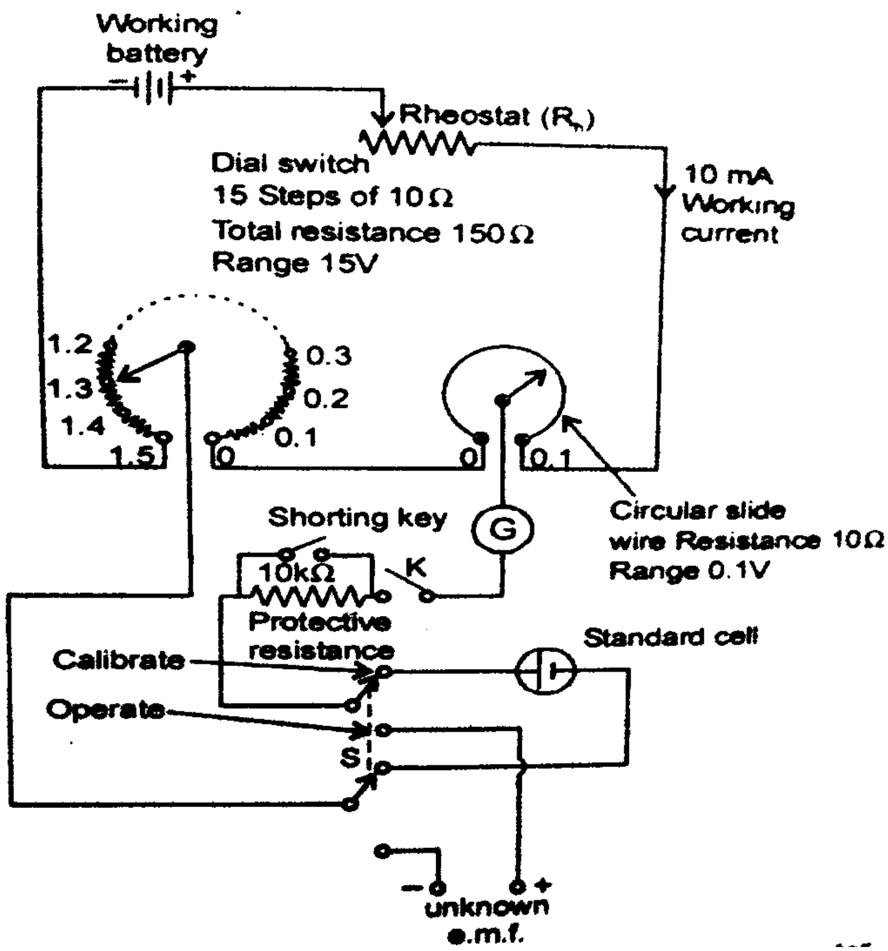
$V_S = IS$ ………. (2)

Dividing (1) by (2)

$$V_R/V_S = R/S$$

⇨ $R = V_R \times S/V_S$

CIRCUIT DIAGRAM:



PROCEDURE:-

(1) Make the connection as shown in the circuit diagram.
(2) Switch 'ON' the supply of potentiometer.
(3) Standardize the potentiometer by connecting the standard cell to standard terminals. Press the standard key and vary the fine coarse knob to indicate zero deflection in galvanometer.
(4) Set the current through series of resistance.
(5) Put terminals 2-2' to test terminals through DPDT.
(6) Now press the 'Test' key and vary the voltage knob so as to have null deflection in galvanometer.

(7) Note down the voltage as indicated by voltage knob (both volts and millivolts). This gives value of V_S.
(8) Now put terminals 1-1’ to test terminals through DPDT.
(9) Now press the ‘Test’ key and vary the voltage knob so as to have null deflection in galvanometer.
(10) Note down the voltage as indicated by voltage knob (both volts and millivolts). This gives value of V_R.
(11) Change the value of current and repeat step 5 to step 10.
(12) Take 5 sets of observations.
(13) Switch off the supply.

OBSERVATION TABLE:-

S= ………….. Ω

S.No.	**V_S in volts**	**V_R in volts**	**$R = V_R \times S/V_S$ in ohms**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

CALCULATION/GRAPH (if any):-

RESULT: - The value of unknown resistance is ……….. Ω .

EXPERIMENT NO.7

OBJECT:-Measurement the low resistance by Kelvin's double bridge.

APPARATUS REQUIRED:-

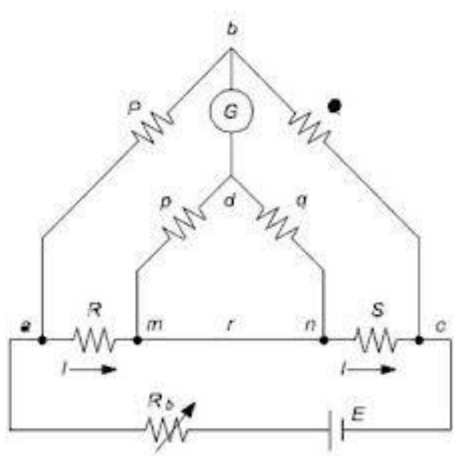
(1) Kelvin Bridge
(2) Regulated DC power supply (0-15V, 10A)
(3) Light spot galvanometer
(4) Conductivity attachments

BRIEF THEORY:-

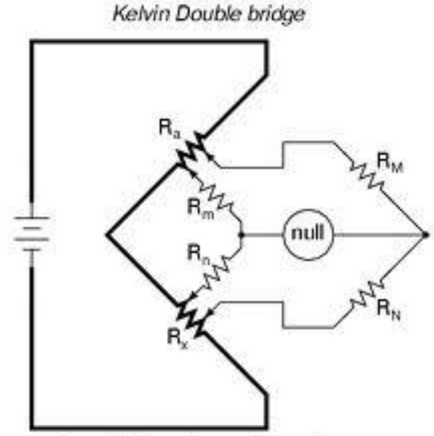
M, Q = Outer ratio arm
m, q = Inner ratio arm
r = Resistance of connecting load
S = Variable standard resistance
X = Unknown resistance
E = D.C Supply voltage
D = Light spot galvanometer

The Kelvin 's Bridge is a modification of the Wheatstone bridge and provides greatly increased accuracy in measurement of value resistance .The bridge is designed to overcome the difficulties that arise in a Wheatstone bridge while measuring low resistance.

CIRCUIT DIAGRAM:-



Kelvin Double bridge



R_a and R_x are low-value resistances

PROCEDURE:-

1. Make sure that current switch is in OFF condition.
2. Connection supply to CURRENT INPUT.
3. Connection light spot galvanometer between G1 & G2.
4. Connection the resistance under test to the Bridge terminal C, C1 and P, P1 as shown in fig. below.
5. Make the connection as stated above.
6. Select the range (x1 & x0.1).
7. Switch on the supply, set the current switch to normal, set the given value of current.
8. Select any value of standard resistance.
9. Insert the galvanometer in the circuit, keep on pressing the galvanometer key intermittently and bring the galvanometer to zero position by changing the value of S
10. S= (main scale reading + venire reading) × range multiplier
11. Once balance is obtained observe S and calculate X.
12. Reverse the direction of current by reversing switch and repeat the above procedure.
13. Set another value of current and repeat the above procedure.
14. Change the value of range multiplier and repeat the steps 4 &13.

OBSERVATION TABLE:-

X = M(R + r)

S .no	Range multiplier	Current setting	value of S (mΩ)						Value of X(mΩ)
1									
2									
3									

RESULT:-The value of resistance is mΩ.

EXPERIMENT NO.8

OBJECT: - Measure the earth resistance by using fall of potential method.

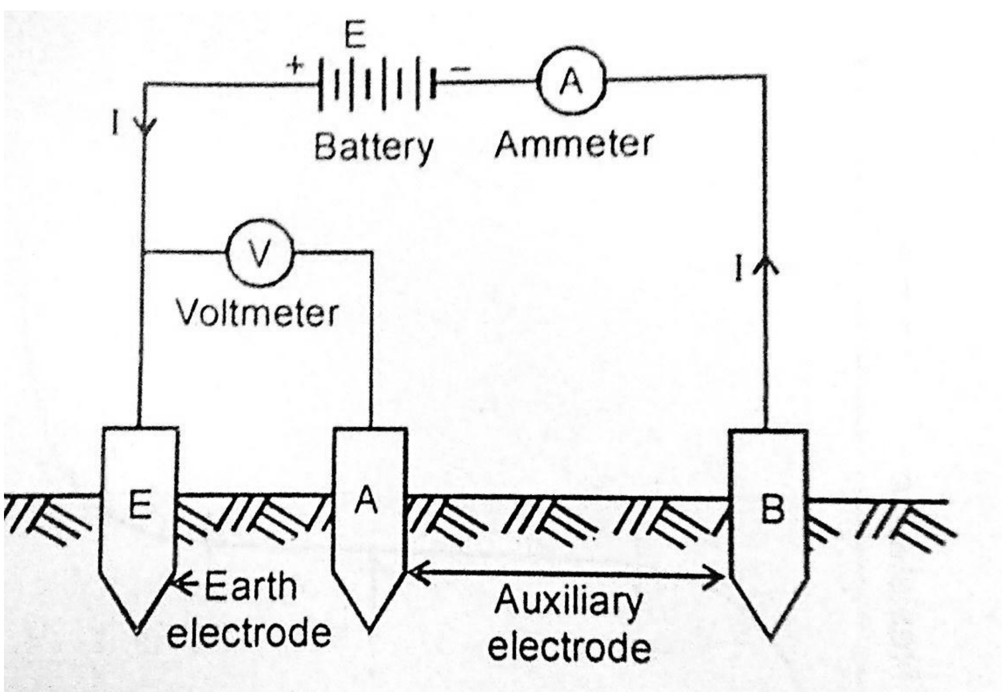
APPARATUS REQUIRED: -

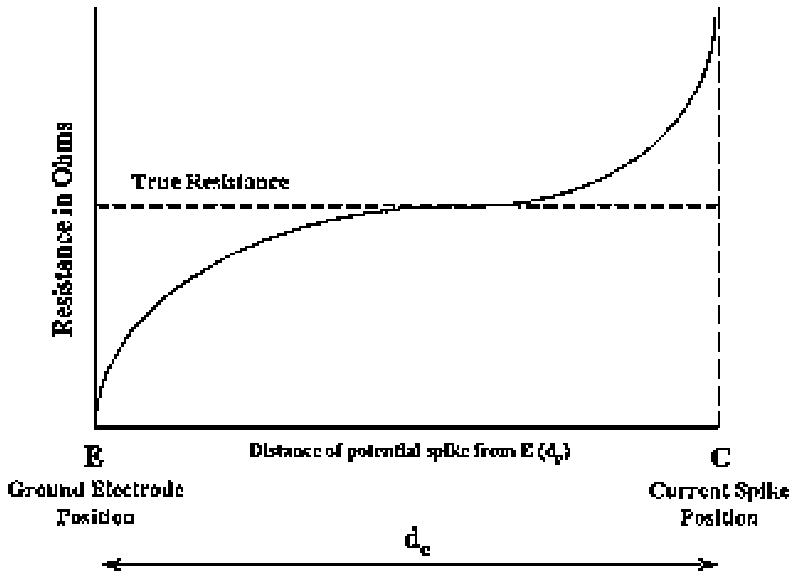
1. Earth resistance tester
2. Hammer
3. Electrodes – 3 Nos.
4. Connecting wires

BRIEF THEORY:-

In this method, a current is passed through earth electrode E to an auxiliary electrode B.A second auxiliary electrode A is inserted in earth between E and B. V_{EA} and I are observed for different positions of A between E and B thereby giving he earth resistance as $R_E = V_{EA}/I$.

DIAGRAM:-





PROCEDURE:-

1) Make the connection at terminal of WACO earth tester as shown in figure (b).
2) Distance between earth electrode (E) and fixed electrode (B) should be nearly 40 feet.
3) In this tester, hand generator gives us the supply.
4) Select the range of the tester.
5) With one fixed position of electrode A, rotted the hand generator and obtain value of R_E directly.
6) Repeat above steps for different position of A between E and B.

OBSERVATIONS: -

a) Near electrode E, resistance rises rapidly.
b) Than for some distance it becomes constant.
c) After that near B, it again starts rising rapidly.
d) The correct reading is the reading which lies in constant region.

OBSERVATIONS TABLE: -

Position of A	Resistance R_E

RESULT: - Find the average of near to constant reading which gives the earth resistance.

EXPERIMENT NO.9

OBJECT: - Calibrate a Single Phase Energy Meter by Phantom Loading Method.

APPARATUS REQUIRED:-

1. Three phase auto transformer
2. Single phase auto transformer (0 -300V, 10 A)
3. Energy meter to be calibrated
4. Sub standard energy meter
5. Power factor meter
6. Wattmeter (0-300V, 5A) UPF
7. Voltmeter (0 – 300V)
8. Ammeter (0 – 5A)
9. Rheostat (102 Ω, 4.2 A)

BRIEF THEORY:-

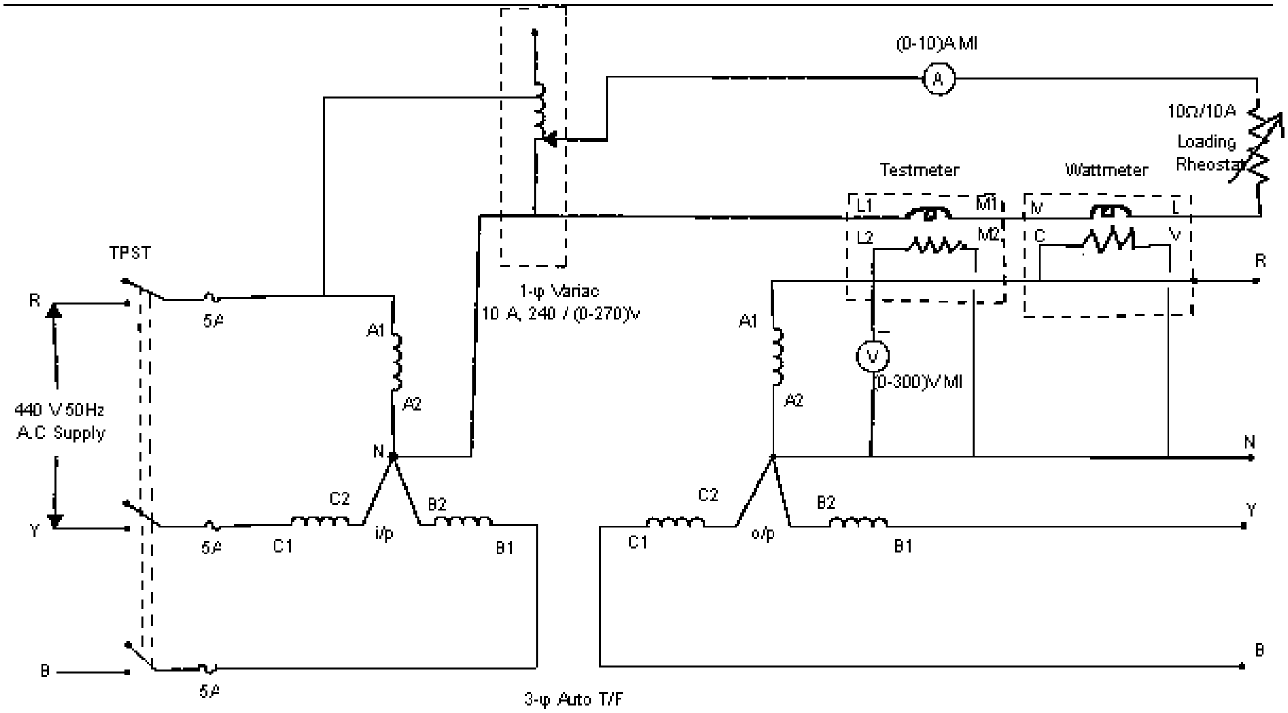
When the current rating of a meter under test is high a test with actual loading arrangement would involve a considerable waste of power. In order to avoid this “phantom” or “Fictitious” loading is done.

Phantom loading consists of supplying the pressure circuit from a circuit of required normal voltage and the current circuit from a separate low voltage supply. It is possible to circulate the rated current through the current circuit with a low voltage supply as the impedance of this circuit is low. With this arrangement the total power supplied for the test is small due to the small pressure coil current at normal voltage, plus that due to the current circuit current supplied at low voltage. The total power, therefore, required for testing the meter with phantom loading is comparatively small.

PROCEDURE:-

1. Make the connections as shown in the circuit diagram.
2. Set the potential of the pressure circuit to the rated.
3. Set the current of the current as defined in the problem.
4. Set the power factor as defined.
5. For five revolutions of the disc record the time.
6. Change the current and power factor setting and repeat step 5.

CIRCUIT DIAGRAM:-



OBSERVATION TABLE:-

V =

S.No.	p.f	% load	Voltage (V)	Current (Amp)	Power (Watt)	Time T(Sec)	No. of Rev.	Ex (kwh)	Es (kwh)	%error (Ex-Es)x100/Es
1.										
2.										
3.										
4.										
5.										

RESULT: -The graph between % error and energy meter reading has been plotted.

Experiment No. 10

EXPERIMENT No. 10

OBJECT: -To determine the self-inductance of a coil by Anderson bridge.

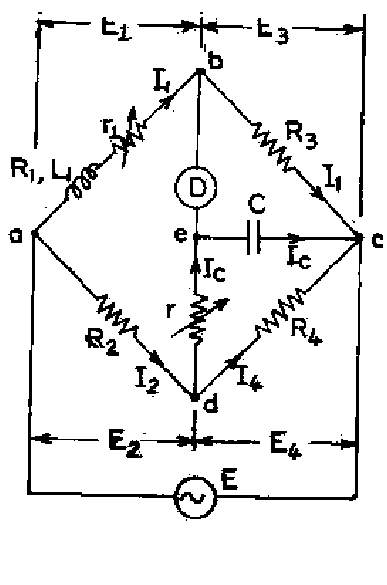
APPARATUS REQUIRED :- (1) Anderson bridge
(2) Headphone for AC null point
(3) Galvanometer for DC null point

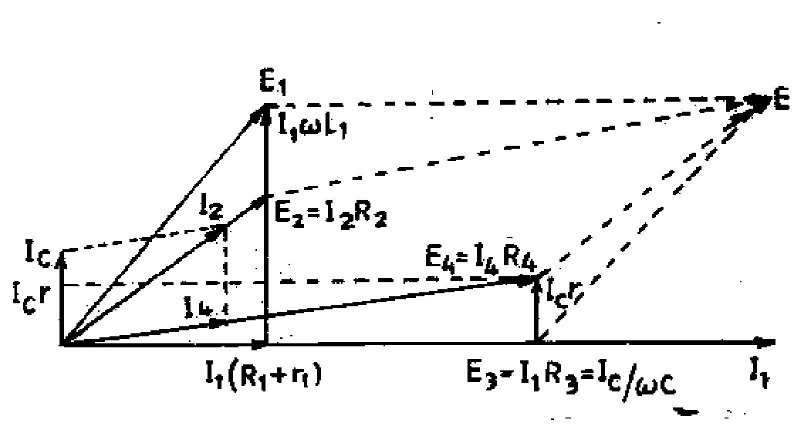
BRIEF THEORY: - Main Features of the bridge:

R = Three-decade resistance dials having value from 1Ω to 1KΩ.
r = Three-decade resistance dials having value from 10Ω to 10KΩ.
C = Two fixed standard capacitors having values 0.1 μF and 0.2 μF
P = Fixed standard values 1000 Ω
Q = Fixed standard values 1000 Ω
S = Single decade resistance dial having values from 0.1Ω to 10 Ω
L = Three unknown inductances

In this bridge, the self inductance is measured in terms of a standard capacitor. The method is applicable for precise measurement of self-inductance over a very wide range of values. This bridge may be used for accurate determination of capacitance in terms of inductance.
An additional junction point increases the difficulty of shielding the bridge. Value of unknown inductance: **- L= CR (Q+2r)**

CIRCUIT DIAGRAM:-





PROCEDURE: -

DC balance (null point)

Make the connection as shown in the fig. with DC supply Galvanometer and one unknown inductance. Now adjust the resistance dial R and press the galvanometer key and get the balance point in the galvanometer. Use the resistance dial S only for fine balance in the Galvanometer and note value of R.

AC Balance With Headphone

Replace the DC supply with AC supply frequency 1 KHz and Galvanometer with headphone as shown in the fig. set the standard capacitors c at the position .1 μF and adjust the resistance dial r to minimize the sound in the headphone. Note the value of resistance dial r and calculate the value of unknown inductance using below formula.

$$L = CR(Q+2r)$$

Repeat the experiment with another value unknown inductance and capacitor $\mathbf{C_1}$.

OBSERVATION TABLE:-

S.No	R(Ω)	C(μF)	r (Ω)	L(mH)
1.				
2.				
3.				

CALCULATION/GRAPH (if any):-

RESULT: - The value of self inductance of coil is……..

EXPERIMENT NO.11

OBJECT: - To compare the capacitance of two condensers by De-Sauty method.

APPARATUS REQUIRED:-

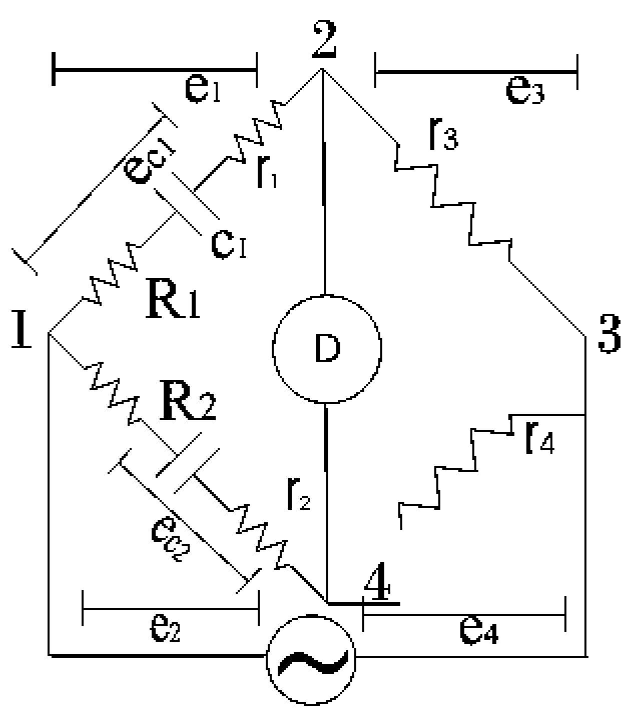
(1) De-Sauty bridge
(2) Head Phone
(3)Connecting Wires)

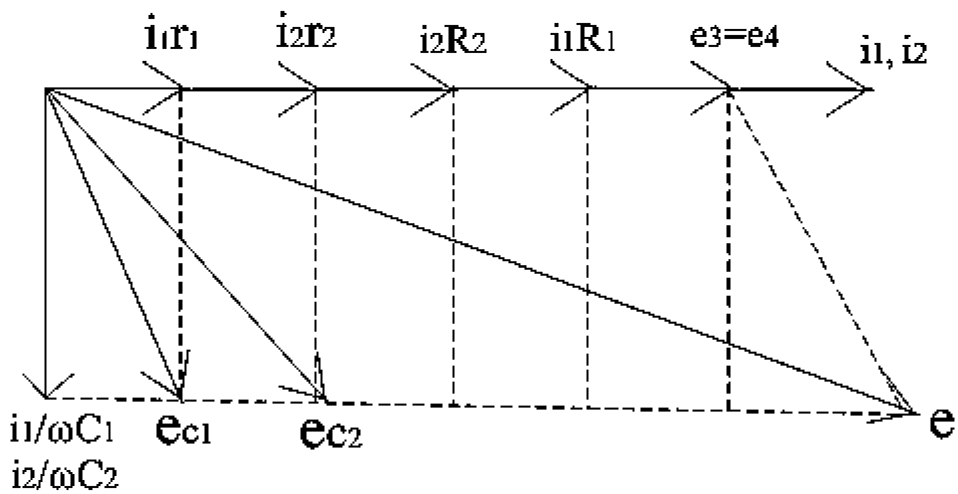
BRIEF THEORY:-

R_1 = Three decade resistance dial having range *1000Ω, *100 Ω, *10Ω
R_2 =Three more decade resistance dials of same values as above
C_1 =Three decade standard capacitance dial having *0.1µF
C_2 =Four unknown capacitors

This bridge is the simplest method of comparing two capacitances. In this method only loss-less capacitor like air capacitors can be compared. In order to make measurements on imperfect capacitors further modification is required.

CIRCUIT DIAGRAM:-





PROCEDURE:-

AC Method :

Make connection as shown in fig. using headphone and AC Supply, set the standard capacitors dial on same value say at 0.1µfd. Now introduce some resistance (say 1000ohms) from decade resistance dial R2 and adjust the decade resistance dial R1 and R2, we can get minimum sound or no sound in the head phone. Note the value of decade resistance dial R1, R2 and decade capacitance dial C1 and calculate the value of unknown capacitance using formula:

$$C2 = (C1 \times R1) / R2$$

Thus, $\frac{C1}{C2} = \frac{R2}{R1}$ & $C2 = \frac{C1 \times R1}{R2}$

In this way you can determine the value of unknown capacitor.

OBSERVATION TABLE:-

S.No.	**C_1** (µF)	**R_1** (Ω)	**R_2 (Ω)**	**C_2**(µF)

RESULT: - The value of unknown capacitances is ……………