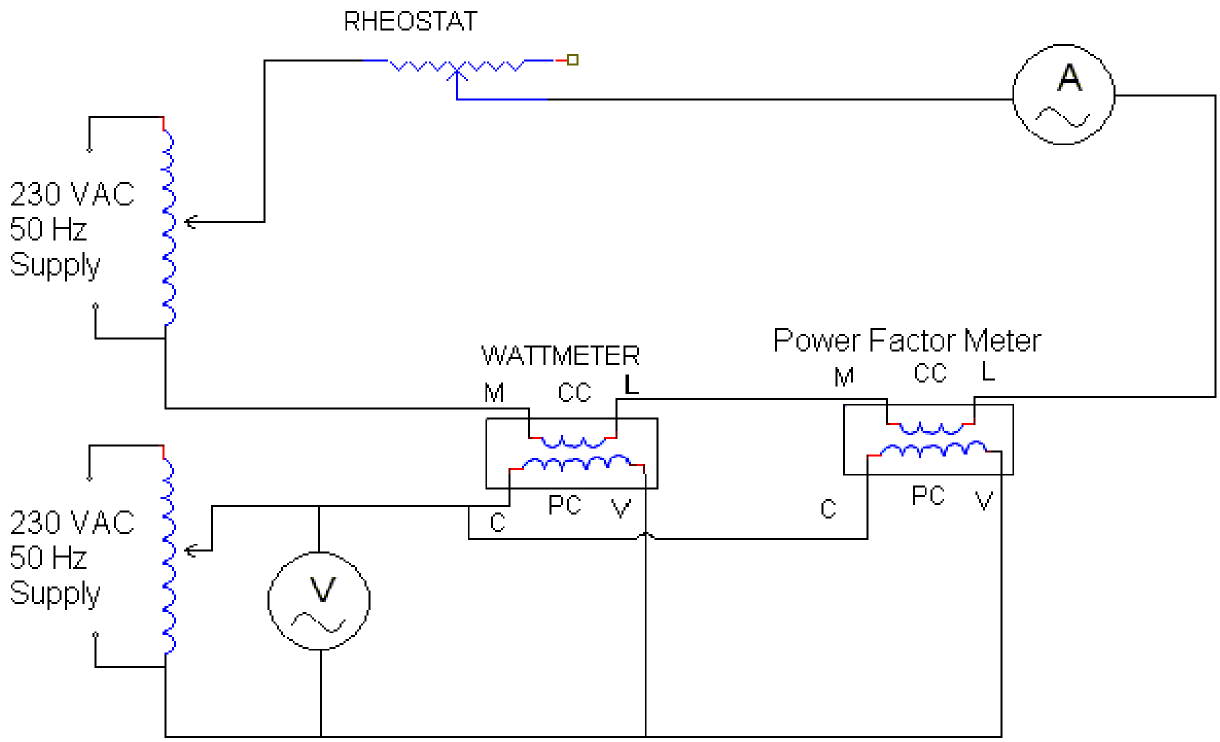
**Circuit Diagram**



**Experiment No:** **Date:**

## 1. CALIBRATION OF DYNAMOMETER TYPE WATTMETER BY PHANTOM LOADING

**AIM:** To calibration of dynamometer type wattmeter by phantom loading.

**Apparatus Required:**

| S. No | Name of the Apparatus | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | Voltmeter | | | |
| 2. | Ammeter | | | |
| 3. | Variac,single phase, | | | |
| 4. | Rheostat | | | |
| 5. | Variac, Single Phase, | | | |
| 6. | Wattmeter | | | |
| 7. | Power factor mete | | | |

**Theory:**

**To be Referred From Text Books**

**Procedure:**

1. Keep the Autotransformer at zero position.
2. Make connections as per the Circuit diagram shown below.
3. Switch on the 230 VAC, 50 Hz. power supply.
4. Increase the input voltage gradually by rotating the Autotransformer in clockwise direction.
5. Adjust the load rheostat so that sufficient current flows in the circuit. Please note that the current should be less than 4A.
6. Note down the Voltmeter, Ammeter, Wattmeter and power factor meter readings for different voltages as per the tabular column.

7. Find out the percentage error by using above equations.

**Observation Tables:**

| S No | Voltage (Vlts) | Current (Amps) | Power (watts) | Power factor Cos Ø | % ERROR |
|---|---|---|---|---|---|
| | | | | | |

**Model Calculations:**

Wattmeter reading = Actual reading

Theoretical reading  P = V I cosΦ

P = Voltmeter reading X Ammeter reading X power factor reading

$$\% \text{ Error} = \frac{\text{Actual Reading} - \text{Theoritical Reading}}{\text{Theoritical Reading}} * 100$$

**PRECAUTIONS:**

1. Instruments used should be of proper range.
2. All the connections should be tight.

**Viva Voice:**

1. What is the difference between moving coil & Fixed coil.

2.What type of control is used for electrodynamometer Type Wattmeter.

3.What is damping.

4.What type of scales &  pointers used for electro dynamometer wattmeter.

5.What are the different types of errors occur as the Wattmeter.

6.What is the power factor.

7. Explain the shape scale.

8.  On What principle does the power factor meter work

**RESULT:**

**Circuit Diagram:**

**CALIBRATION OF VOLTMETER**

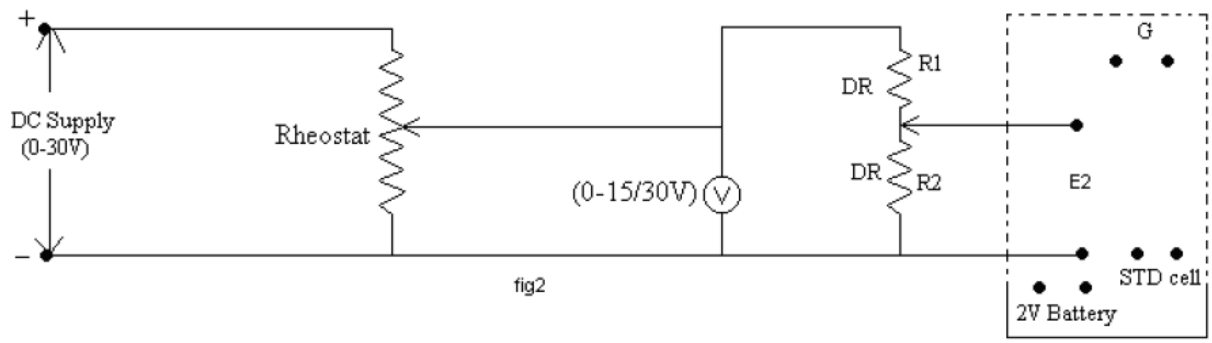



fig2

**Experiment No:** **Date:**

# 2.CROMPTON D.C. POTENTIOMETER

**Aim:** To measure the unknown E.M.F and current using Crompton Potentiometer and to calibrate the given PMMC voltmeter.

**Apparatus Required:**

| S. No | Name of the Apparatus | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | RPS | | | |
| 2. | Voltmeter | | | |
| 3. | Volt Ratio box | | | |
| 4. | Standard cell | | | |
| 5. | Connecting wires | | | |
| 6. | Potentiometer | | | |

**Theory:**

**To be referred from Text books**

**Procedure:**

**PMMC Voltmeter:**

1. The connections are given as per the circuit diagram by selecting suitable voltage range in Voltage Ratio Box.
2. The combination of main dial resistor (volts) & slide wire (mV) is set to the standard cell voltage.
3. Press the STANDARDIZED key of the potentiometer to obtain balance (zero deflection) in galvanometer by adjusting the battery rheostat coarse and fine knobs. So that standardization is obtained.
4. Press the TEST key and balance the potentiometer by varying or by rotating the battery rheostat coarse and fine knobs.

5. Now measure the voltage obtained in the potentiometer and then multiply it by voltage ratio.
6. Calculate the % ratio error of the TEST meter by comparing the voltage obtained from the potentiometer and the voltage obtained from the voltmeter.

$$\% \text{ error} = \frac{Vs-Vt}{Vt} * 100$$

Vs = Crompton Pm voltage (Pm=Potentiometer)

Vt = Voltage measured by voltmeter

**Observation Tables:**

**PMMC Voltmeter:**

| S. No | Actual Voltage in voltmeter (volts) | Reading from Potentiometer | $\frac{Vs-Vt}{Vt}$ | % Error |
|---|---|---|---|---|
| 1<br>2<br>3 | | | | |

**Precautions:**

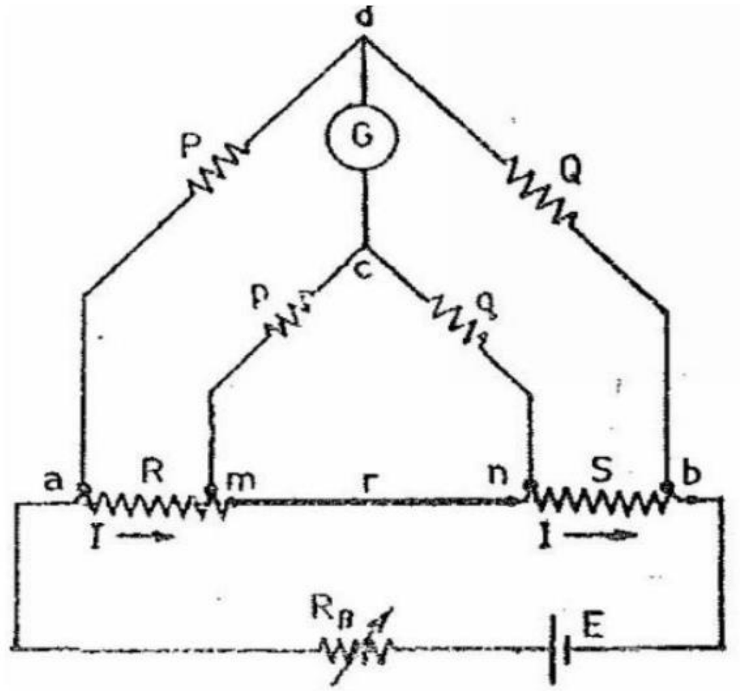
1. Connections are to be made as per circuit diagram.
2. Readings are to be noted without any error.
3. All the connections are to be made tight.

**Viva-Voce:**

1. What is potentiometer?
2. What are the applications of potentiometer?
3. What is standardization?
4. Explain the process of standardization?
5. How do you measure current using potentiometer?
6. When protective resistance in galvanometer circuit is short circuited across galvanometer?
7. What is working current?
8. What is slide wire?
9. Why slide wires in potentiometers are made only of manganin?
10. What is the use of Voltage Ratio Box?

**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

# 3. KELVIN'S DOUBLE BRIDGE

**Aim:** To measure the low resistance by using Kelvin's double bridge.

**Apparatus Required:**

| S. No | Name of the Apparatus | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | Kelvin's Double Bridge Kit | | | |
| 2. | Rheostats | | | |
| 3. | Connecting Wires | | | |

**Theory:**

**To be Referred From Textbooks**

**Procedure:**

1. Connect the circuit as shown in the diagram.
2. Keep the current switch at 'OFF' position.
3. Set the 12V supply in the DC battery.
4. Now keep the current switch value at 'NORMAL'.
5. Set the multiplier value (say 'X10').
6. Now adjust the 'Milli Ohms Fine (multiplier of 10mΩ)' & 'Milli Ohms Coarse (multiplier of 0.1Ω)'.
7. Press the 'INITIAL' button, and see whether the galvanometer deflects or not. If it deflects, repeat the steps 5 & 6 until the galvanometer shows zero deflection when 'INITIAL' button is pressed.
8. If the galvanometer shows zero deflection, Keep the current switch at 'REVERSE' position, and check whether the galvanometer is deflecting or not.
9. When galvanometer shows no deflection, take the values of Coarse, Fine and multiplier and calculate the value of unknown resistance by formula.

$R = n(C+F) * 10^{-3}\ \Omega$ where, C=Coarse value, F=Fine value, n=multiplier

**Observation Table:**

| S. No | Multiplier | Resistance(Coarse)mΩ | Resistance (Fine)mΩ | $R=n*(C+F)*10^{-3}\ \Omega$ |
|---|---|---|---|---|
| | | | | |

**Precautions:**

1.Connections are to be made as per circuit diagram.

2. Readings are to be noted without any error.

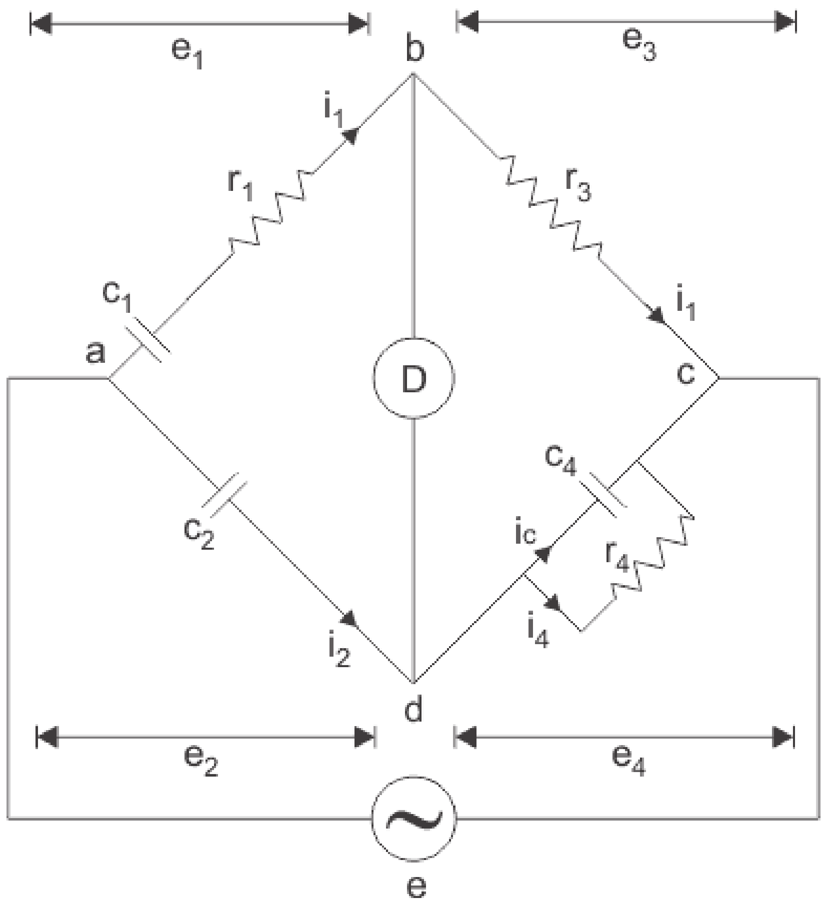
3.Fine tuning of the Resistance has to be done.

**Viva-Voce:**

1. What is the difference between Wheat-stone Bridge and Kelvin's double Bridge?
2. What do you mean by low resistance?
3. What do you mean by medium resistance?
4. What do you mean by high resistance?
5. How does a megger differ from ohm meter?
6. Why is megger provided with a slipping clutch?
7. What is megger?

**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

# 4. SCHERING BRIDGE

**Aim:** To measure the capacitance of given capacitor using Schering Bridge.

**Apparatus Required:**

| S. No | Name of the Apparatus | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | Schering Bridge Kit | | | |
| 2. | Headphones | | | |
| 3. | Connecting Wires | | | |

**Theory:**

**To be referred From Text books**

**Procedure:**

1. Check the o/p of 1 kHz oscillator.
2. Note down the values of $R_3$, $C_2$.
3. Set $R_4$ at maximum & $r_1$ at minimum resistance.
4. Form the bridge as shown on the front panels by making all connections.
5. Choose the values of standard capacitor, $C_4$.
6. Connect the unknown capacitance, $C_5$ at 'C' terminal on the trainer.
7. Now apply 1 kHz Signal at bridge i/p terminal.
8. Connect the head phones at detector terminal & listen for sound.
9. Now, vary $R_4$ for min sound. At one value of $R_4$ sound will be minimum. Fix $R_4$ at that value & do not disturb it.
10. Now vary $r_1$ for least sound. Fix '$r_1$' at value where the sound is less. Now parallel vary $R_4$, $r_1$ to get even less sound; at one point the sound will not become complete silent due to dielectric loss of capacitors.
11. Note down the various values of $R_4$, $r_1$, $C_4$.
12. Calculate the unknown capacitance using the formula.

$$C_1 = R_4 / R_3 * C, \text{ where } C = C_5$$

$r_1 = C_4/C_2 * R_3$

13. Calculate the dissipation factor $D=\omega C_1R_1$, $\omega C_4R_4$.
14. Repeat the above procedure with different values of standard capacitances & compare and also repeat for different values of unknown capacitances $C_6$, $C_7$, $C_8$, and $C_9$.
15. The theoretical & practical values may be slightly different due to various factors such as dielectric loss of capacitors, tolerance of resistors & some other factors.

**Precautions:**

1. Initially set $R_4$ at maximum value and $r_1$ at zero ohms.
2. The experiment should be performed at a silent place.
3. There can't be perfect silence in the head phones only min sound is fed.

**Observation Table:**

| S. No | $C_4$ (F) | $R_4(\Omega)$ | $R_1(\Omega)$ | $R_3(\Omega)$ | C (F) |
|---|---|---|---|---|---|
| | | | | | |

**Viva-Voce:**

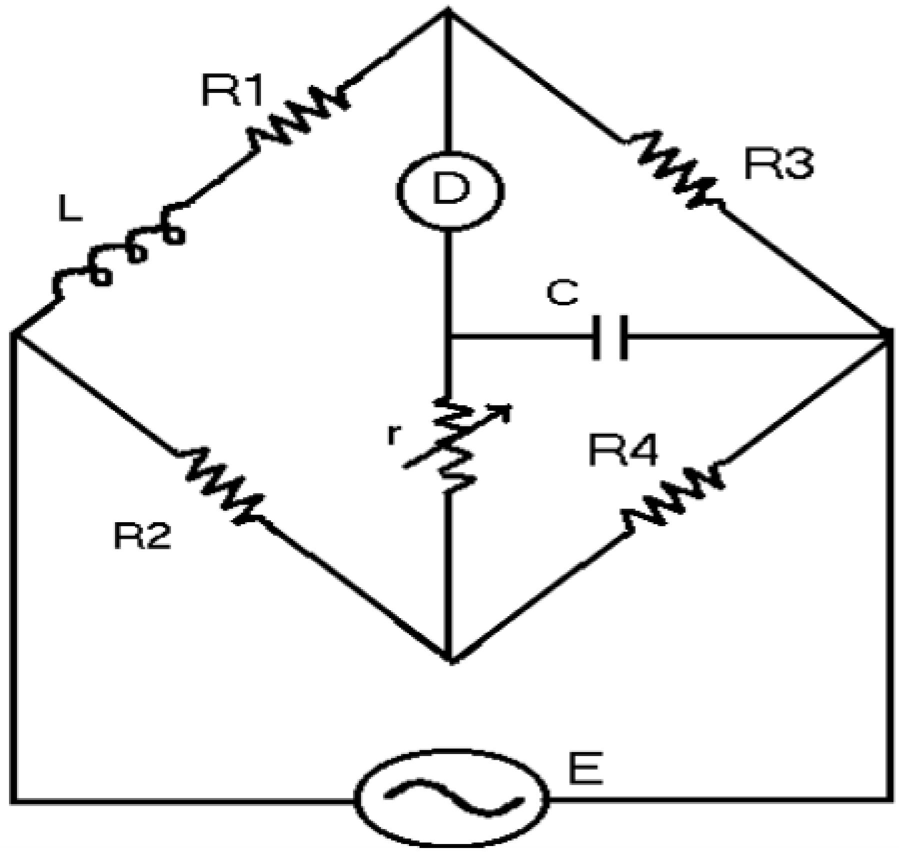
1. Why a spark is connected across resistance arms in a Schering bridge?
2. The most useful ac bridge for comparing capacitances of two air capacitors is_______________________________
3. Dissipation factor of a capacitor can be determined by using a ________________________
4. The capacitance and dielectric loss of a capacitor is generally measured by ____________
5. A bridge used for measurement of dielectric loss and power factor is __________________
6. The bridge used for measuring inter –electrode capacitance is_____________________
7. The bridge used for measuring dissipation factor of a capacitor is____________________
8. Most commonly used AC bridge circuit for the measurement of capacitance is________

9. The bridge suitable for measurement of capacitance of a capacitor at high voltage is ___________

10. Why is Schering Bridge particularly suitable for measurement at high voltage?

**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

# 5.ANDERSON BRIDGE

**Aim:** To measure the self inductance of a given coil using Anderson's Bridge

**Apparatus Required:**

| S. No | Name of the Apparatus | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | Anderson's Bridge kit | | | |
| 2. | Head phones | | | |
| 3. | Connecting Wires | | | |

**Theory:**

**To be referred from Textbooks**

**Procedure:**

1. Note down the practical resistances of $R_1$, $R_2$ and $R_4$.
2. Form the Anderson's bridge as shown on front panel with the help of patch cards.
3. First the bridge should be balanced for DC to find the DC resistances of self inductance. As $R_{1,}$ $R_{2,}$ $R_4$ are equal to 1kΩ, the fourth arm total resistance should also be 1kΩ.
4. Apply +12V DC into the bridge supply terminals & connect the galvanometer at detector terminals. Connect the inductor at inductor terminals.
5. Set 'r' at 0Ω. Now slowly vary $R_3$ till the galvanometer shows the zero deflection. Do not disturb it throughout the experiment. The DC resistance of the inductor is equal to 1000Ω minus value of $R_3$.
6. Now connect audio oscillator of 1 kHz and head phones at detector terminals.
7. Now initially vary 'r' for min sound for i.e. for second balance.
8. At one value of 'r', the sound will be minimum. Since the capacitor has some dielectric loss in the head phones, perfect silence cannot be obtained but minimum sound can be obtained.
9. Now, slowly vary 'r' and $R_3$ simultaneously for least sound.

10. The value of ‘C’ should be chosen that there is sufficient adjustment in the value of ‘r’ when ‘C’ will be small & ‘r’ will be large.
11. Now, note down all the values such as C & r, $R_3$ etc. The value of self inductance can be found out by the formula.

$$L=C(r\,(R_1+R_2)+R_1R_4)$$

12. The bridge is useful for measuring small value of inductance in the range of 50mH to 200mH.

Note: The capacitor value of 0.01µF or 0.02µF should be used for obtaining best results. The value of ‘r’ will be between few Ω to few kΩ.

**Observation Tables:**

| S. No | C (µF) | r (kΩ) | $R_3$ (Ω) | L (mH) |
|---|---|---|---|---|
| | | | | |

**Calculations:**

**Precautions:**

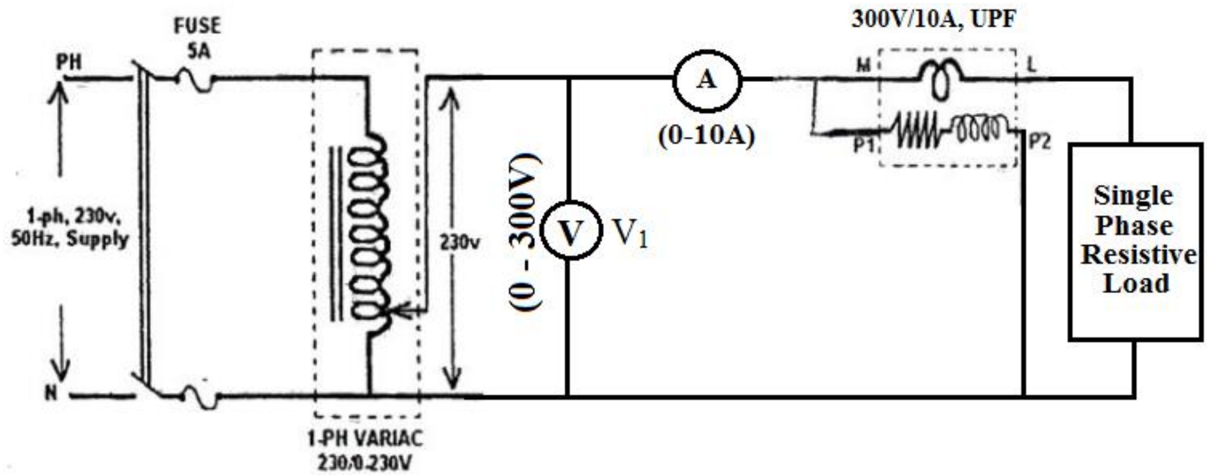
1. The value of capacitor ‘C’ should be small so as to allow sufficient variation of ‘r’.
2. There can’t be perfect silence in the head phones.
3. The experiment should be performed at silent place.
4. Initially set $R_3$ and ‘r’ at 0Ω.

**VIVA-VOICE:**

1. Maxwell bridge is used for measurement of __________________________
2. Maxwell’s bridge is very convenient and useful bridge for determination of Inductance of a coil having _________________________
3. Why there are two conditions of balance in AC bridges?
4. Why is high grade insulation employed in high impedance bridges?
5. Why are highly sensitive detectors undesirable for the operation of AC bridges?
6. In an Anderson bridge , the unknown inductance is measured in terms of_________________
7. Anderson bridge is used for the measurement of ______________________
8. Anderson bridge is a modification of __________________________________
9. Anderson bridge is used to measure_______________________

**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

# 6.CALIBRATION OF LPF WATTMETER

**Aim:** To calibrate single phase dynamometer type Wattmeter.

**Apparatus Required:**

| S. No | Name of the Apparatus | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | Single phase variac | | | |
| 2. | Voltmeter | | | |
| 3. | Ammeter | | | |
| 4. | Wattmeter | | | |
| 5. | Resistive Load | | | |

**Theory:**

To be written by Student by referring Text book

**Procedure:**

1. Make the connections as per the circuit diagram.

2. Keep the variac at zero position before starting the experiment.

3. Switch on A.C supply.

4. By varying the variac set the voltmeter reading as supply voltage.

5. Vary the Resistive load to obtain different readings of Voltmeters, Ammeter and wattmeter.

6. Repeat step 5 for different loads.

**7.** Set the variac at zero position and switch of supply.

**Precautions:**

1. It is observed that all connections must be tight.

2. It is observed that while giving the supply to the circuit, load is in off condition.

**Observation Table:**

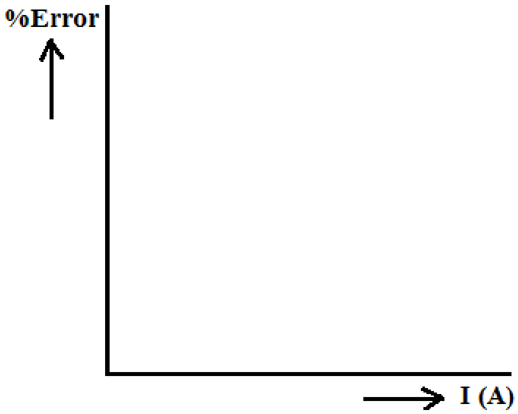
| S. No | V (Volts) | I (Amps) | Pcal (V*I) | W | % Error |
|---|---|---|---|---|---|
| | | | | | |

**Model calculations**

P = (V * I)

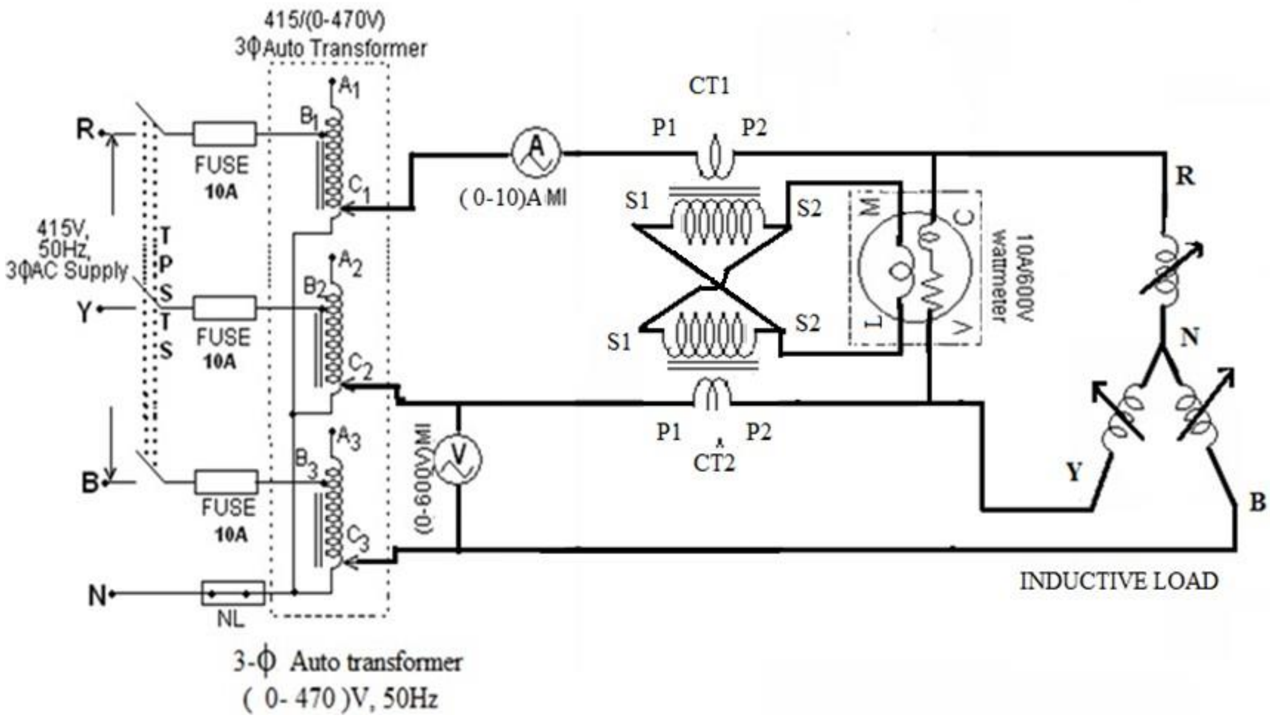
% Error = [(W – P)/P] * 100

**Model Graph:**




**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

# 7. Measurement of 3 phase power with single watt meter and 2 No's of C.T.

**Aim:** To measure the three phase power by using a single Watt meter and 2 CT'S.

**Apparatus required:**

| Sl.no. | Name of the component | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | Watt meter | LPF | | 1 no |
| 2. | CT's | | | 2 no |
| 3. | Voltmeter | M.I | | 1 no |
| 4. | Ammeter | M.I. | | 1 no |
| 5. | 3- ϕ Variac | | | 1 no |
| 6. | 3- ϕ variable inductive load | | | 1 no |

**Theory:**

To be written by Student by referring Text book

**Procedure:**

1. Make the connections as per the circuit diagram.
2. Keep the 3- ϕ variac in minimum position and close the TPST Switch.
3. Vary the 3- ϕ variac gradually and apply the rated voltage (415V).
4. Note down all the meter readings at no-load position and tabulate them.
5. Vary the inductive load in steps up to the rated CT'S current and tabulate the meter readingsin each step.
6. Reduce the load to zero position; reduce the voltage to zero gradually by varying the 3- ϕ variac and open the TPST switch.

**Observation table:**

| Sl.no. | $I_l$ (Amp) | $V_l$ (Volt) | $V_l$ / $I_l$ (Ohm) | Wattmeter reading | Power loss in the load (Watt) | % Error |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |

**Precautions:**

1. Avoid loose connections so that the readings will be absolute.
2. The secondary of CT’s should not be open.

**VIVA-VOICE:**

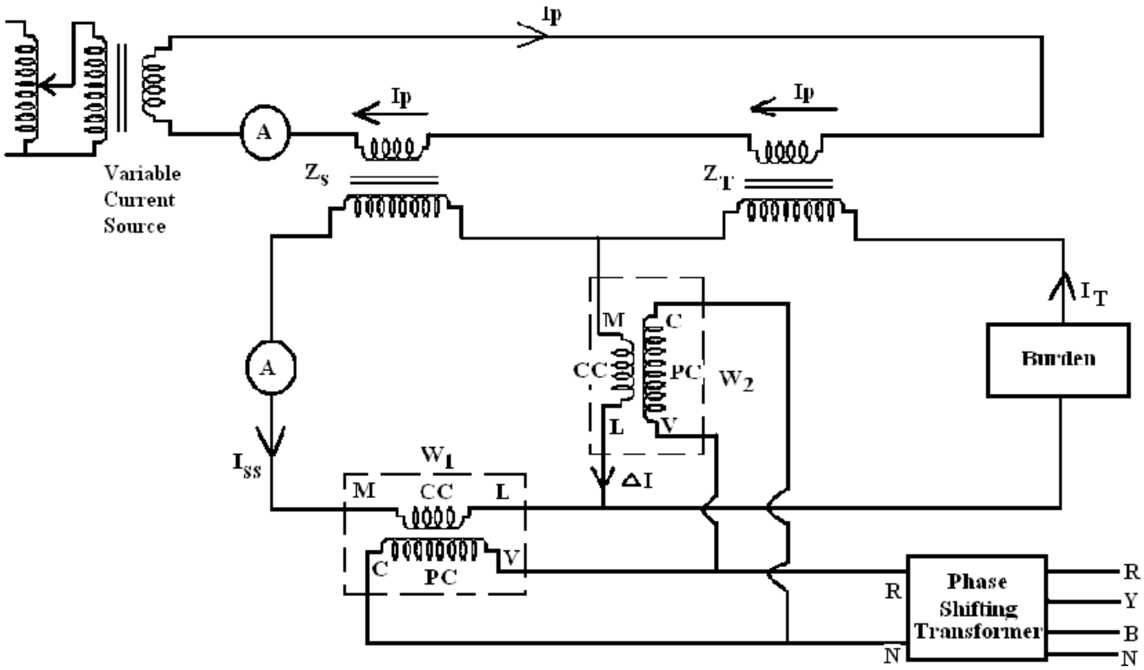
1. Why the C.T's Secondary is not open?

2. Give the ratings of C.T's Used in substations.

3. What are the applications of C.T's?

**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

# 8.Testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.

**Aim:-** To measure percentage ratio error and phase angle of given ct by null method .

**Method:** Silsbee's deflectional method.

**Apparatus:** Watt meters (2 Nos.), Standard current transformer having the same nominal ratio as the C.T. under test, Ammeter, Adjustable load (burden for the C.T. under test), Phase Shifting transformer connected to a single phase supply.

## THEORY:

Silsbee's method is a comparison method. There are two types of Silsbee's methods: deflection and null. Only deflection method is described here. Here the ratio and phase angle of the test transformer X are determined, in terms of that of a standard transformer S having the same nominal ratio. The two transformers are connected with their primaries in series. An adjustable burden is put in the secondary circuit of the transformer under test.

An ammeter is included in the secondary circuit of the standard transformer so that the current may be sent to the desired value.W1 is a wattmeter whose current coil is connected to carry the secondary current of the standard transformer. The current coil of wattmeter W2 carries current $\Delta I$ which is the difference between the secondary currents of the standard and test transformer s. The voltage circuits of the wattmeter's (i.e; their pressure coils) are supplied in parallel from a phase shifting transformer at a constant voltage V.

## Procedure:

a) Connect the C.T. under test (T) as given in the circuit diagram to the standard C.Tand the other equipment given under 'apparatus' mentioned above.

b) Adjust the phase of the voltage(V) given to the wattmeter's by varying the phase shiftingtransformer. The phase of this voltage is to be adjusted such that wattmeter W1 reads zero.Voltage V is in quadrature with current Iss as given in the phasor diagram.

c) Note the reading of the wattmeter W2. Let this be $W_{2q}$.

d) The phase of the voltage V is shifted through $90^0$ so that V is phase with Iss.Note the readings of both Wattmeters W1 and W2. Let the reading of Wattmeter W1 be $W_{1p}$ and le the reading of wattmeter w2 be $W_{2p}$.

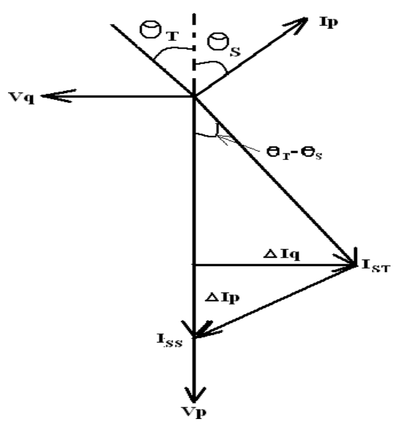
e) The ratio of the standard (C.T) transformer be $R_S$ and that of the C.T. under test be $R_T$.

$$\text{There } R_T = R_S\left(1+\frac{W2p}{W1p}\right)$$

$$\text{The Phase angle of the transformer under test is } \theta_T = \frac{W2q}{W1p} + \theta_S \text{ rad}$$

Where $\theta_S$ is the phase angle of the Standard C.T. in radian.

## Phase Diagram




## Calculations:

Nominal ratio of standard C.T = 4

Ratio error of standard C.T = 0.5%

Phase angle error of standard C.T = 8

Actual ratio of standard C.T =4(1+0.005) =Na'

Phase angle error for the C.T Under test = ΘT = W2q W1p + ΘS rad.

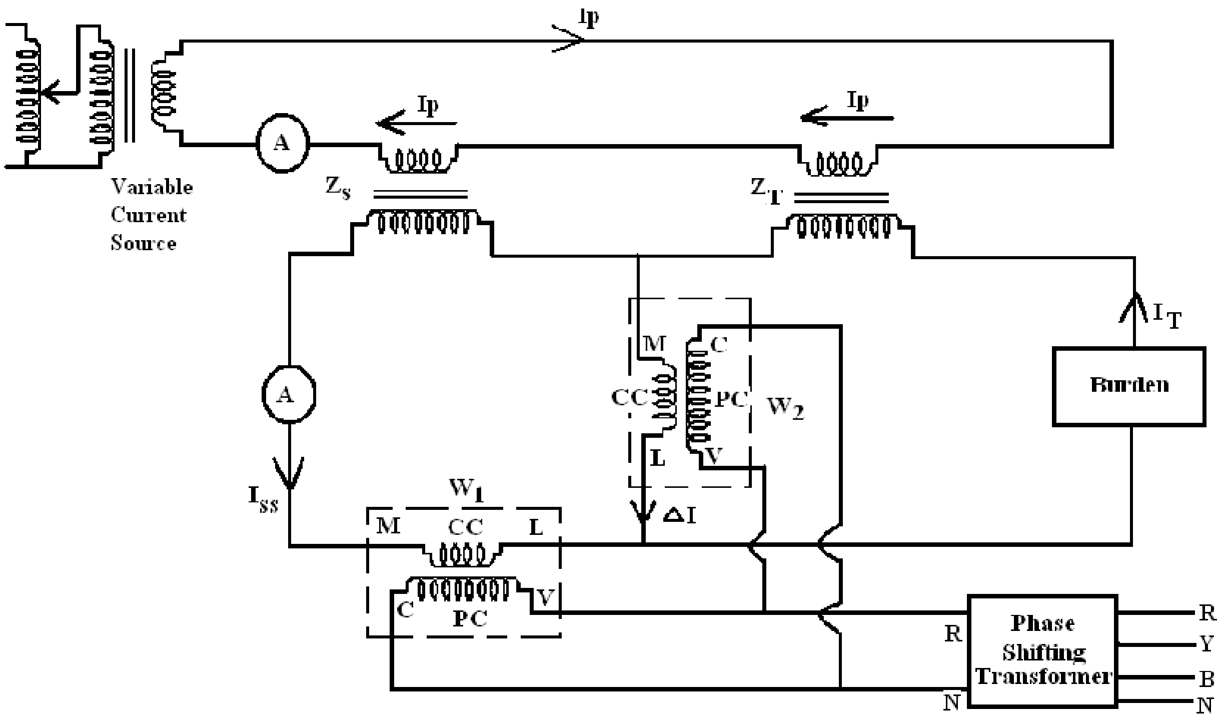
%Error = NR-AR/AR(RT)

## Observation table:

| S.NO | $I_P$(A) | Iss(A) | $I_D$(A) | $W_{2q}$(A) | $W_{1p}$(W) | $W_{2p}$(W) | Ratio Error | Phase angle error |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

## Result:

**Circuit Diagram:**



**Experiment No:** **Date:**

# 9. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.

**Aim:** To obtain the ratio and phase angle errors of the given Potential transformer.(P.T).

**Method:** Comparison method.

**Apparatus:** Watt meters (2 Nos.), Standard Potential transformer having the same nominal ratio as the P.T. under test, Ammeter, (P.T. under test), Phase Shifting transformer connected to a single phase supply.

## Theory:

Method using Wattmeter's. This method is analogous to silsbee's deflectional comparison method for potential transformers. The arrangement is shown in Fig.The ratio and phase angle errors of a test transformer are determined in terms of those of a standard transformer S having the same nominal ratio.

The two transformers are connected with their primaries in parallel. A burden is put in the secondary circuit of test transformer. W1 is a wattmeter whose potential coil is connected across the secondary of standard transformer. The pressure coil of wattmeter W2 is so connected that a voltage ∆V which is the difference between secondary voltages of standard and test transformers, is impressed across it. The current coils of the two watt meters are connected in series and are supplied from a phase shifting transformer. They carry a constant current I.

## Procedure:

a) Connect the P.T. under test (T) as given in the circuit diagram to the standard P.T and the other equipment given under 'apparatus' mentioned above.

b) Adjust the phase of the voltage(V) given to the watt meters by varying the phase shifting transformer. The phase of this voltage is to be adjusted such that wattmeter W1 reads zero.

c) Under these conditions current I is in Vss quadrature with voltage Vss. The position of current phasor for this case is shown in figure.

d) Note the reading of the wattmeter W2. Let this be W2q.

e) The phase of the current I is shifted through 900 so that it occupies a position Ip is in phase with Vss. Note the readings of both Wattmeters W1 and W2.

Let the reading of Wattmeter W1 be W1p and let the reading of wattmeter w2 be W2p.

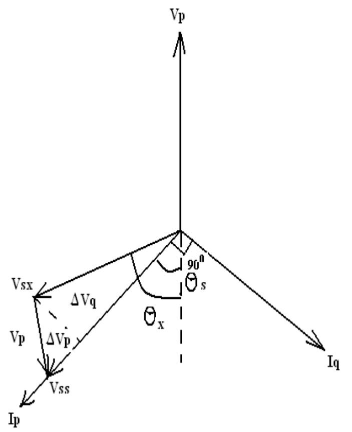
f) The ratio of the standard (P.T) transformer be RS and that of the P.T. under test be RT.

There RT = RS (1+W2p W1p)

The Phase angle of the transformer under test is ϴT = W2q /W1p + ϴS rad.

Where ϴS is the phase angle of the Standard P.T. in radian.

**Phase Diagram**




## Calculations:

Nominal ratio of standard P.T = 4

Ratio error of standard P.T = 0.92%

Phase angle error of standard P.T = 3

Actual ratio of standard P.T =4(1+0.0092) =Na’

Phase angle error for the P.T Under test = $\Theta_T = \frac{W2q}{W1p} + \Theta_S$ rad.

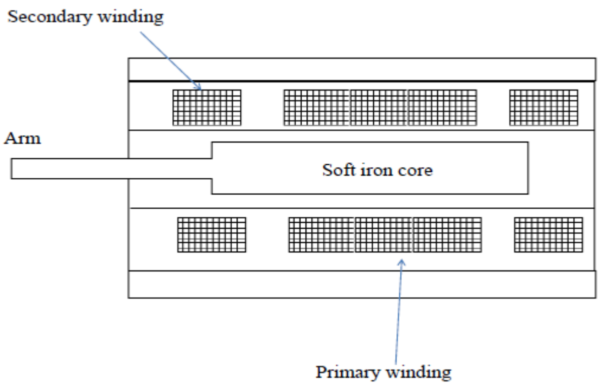
%Error = NR-AR/AR($R_T$)

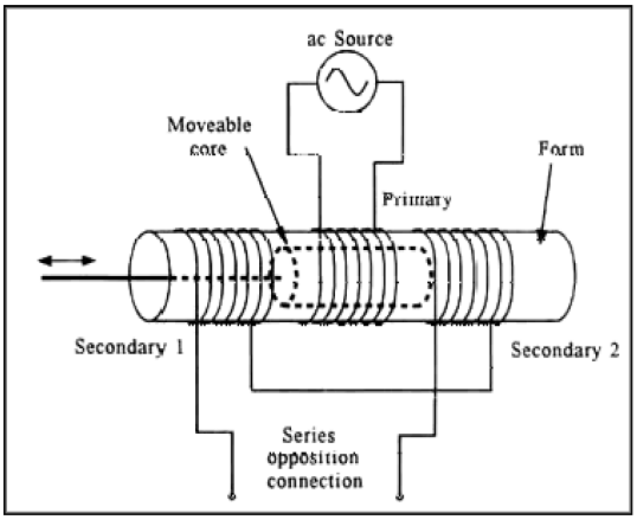
**Observation Table:**

| S.NO | $V_P$(V) | Vss(V) | $W_{2q}$(W) | $W_{1p}$(W) | $W_{2p}$(W) | Ratio Error | Phase angle error |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

# 10.LVDT AND CAPACITANCE PICKUP – CHARACTERISTICS AND CALIBRATION

**Aim:**

To measure the electric voltage corresponding to the mechanical displacement of core.

**Apparatus:**

1. Digital IT LVDT model.
2. LVDT with calibrated scale arrangement.

**Theory:**

**To be referred from Textbooks**

**Procedure:-**

1) Connect the terminals marked "PRIMARY" on the front panel of the instrument to the terminals marked "PRIMARY" on the transducer itself, with the help of the flexible wires provided along with. Observe the Color code for the wires provided and the Color of the binding posts.

2) Identically establish connections from terminals marked "SECONDARY". Observe the Color code for the wires provided and the Color of the binding posts.

3) Keep pot marked "MAX" in most anti clockwise position.

4) The magnetic core may be displaced and the pointer may be brought to zero position. If the DPM is not indicating zero, use potentiometer marked "MIN" to get a zero on DPM at zero mechanical position. If the core is displaced in both directions, the meter must show indications with appropriate polarity. Now displace the core to 19mm positions in one of the directions. Adjust the "MAX" pot to get an indication of 19.00 on the DPM under these conditions. Now the set up is ready for experimentation. You may again check for zero position also.

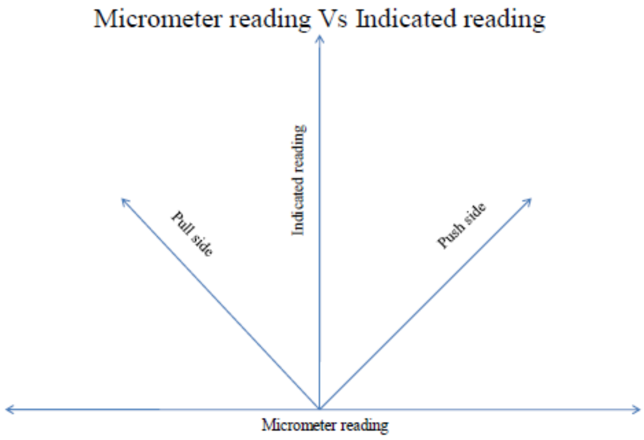
5) Now the core can be displaced by a known amount in the range of +19 to -19mm and the meter readings can be entered in the table. It may be noted that by inter changing the secondary terminals or the primary, the polarity of the meter indication can be reversed for a given direction of input displacement.

6) For LVDT provided with dial gage (range 0 to 1mm or 0 to 25mm or 0 to 2mm), adjust the magnetic core carefully by rotating the control knob in the clockwise direction. Note that for this type (Dial gage type) arrangement, displacement in only one direction i.e. positive direction is possible.

**Tabular Form:**

| S.No | Input Displacement | Output displacement | % Error |
|---|---|---|---|
| | | | |

**Model Graph:**




**Observations:**

1) When C.R.O. is connected between terminal and ground, one can observe the waveform of amplified secondary of pick up coil voltage (TP-1). Between terminal 2 and ground observe the waveform of phase sensitive detector (half sinusoidal TP-2).

2) Between terminal 3 and the ground observe the square waveform of reference signal used for phase sensitive detection (TP-3).

3) Across the primary terminals, waveform for excitation voltage can be observed.

**Precautions:**

1) While connecting lead wire from panel to transducer, make proper connections following color code. Avoid shorting of the excitation source terminals.

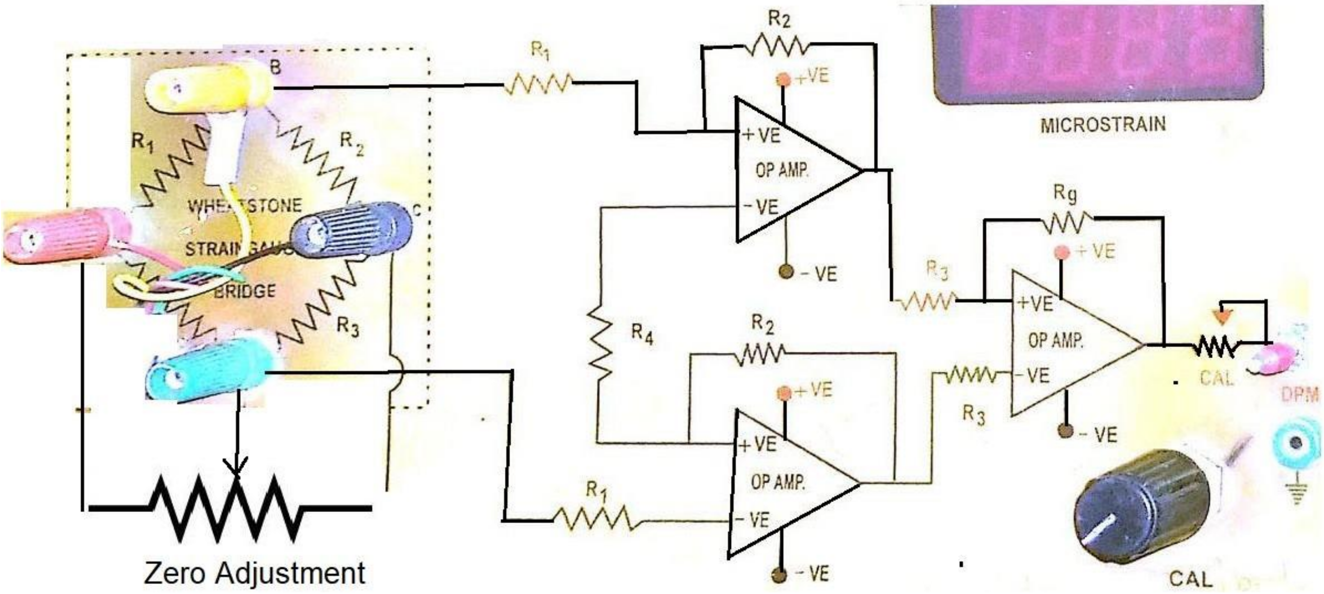
2) Move the core with a gentle fashion by operating the knob for core movement very carefully. Do not try to effect the core movement beyond 10mm/ 20mm/25mm as per the given range.

**Viva Voice:**

1. What is LVDT?
2. What are the uses of LVDT?
3. Core of LVDT is made up of which material?
4. LVDT is active transducer or passive?
5. What is the working principle of LVDT?
6. Write any two advantages of LVDT?
7. Write disadvantage of LVDT.
8. How many secondary's are there in LVDT?
9. LVDT is which type of Transducer?
10. How do we take the output of LVDT?

**Result:-**

## Circuit Diagram:



**Experiment No:** **Date:**

# 11. Measurement of strain using strain gauge

**Aim:** Resistance strain gauge-strain measurements and calibration.

**Apparatus required:**

| S.no. | Name of the component | Type | Range | Quantity |
|---|---|---|---|---|
| 1. | Strain measuring setup | | | 1no. |
| 2. | Cantilever beam | | | 1no. |
| 3. | Weight – 100gm | | | 10nos. |
| 4. | Digital multimeter | | | 1no. |

**Theory:**

Strain is defined as compression per unit area. The primary quantities like resistance, capacitance are measured with the strain gauge element, where force applied to any elastic material, results in strain.

$R = \rho L / A$

Where

R= resistance (Ω)

ρ= Resistivity (Ω-m)

L= Length of wire (m)

A= Uniform cross- sectional area of wire (m2 )

If a metal wire or conductor is stretched or compressed its resistance changes because of change in length, change in resistivity and change in cross sectional area. This effect is called piezo resistive effect. The cantilever used in the primary elastic transducer of force measuring system, where a known mass is attached to cantilever, the unbalanced voltage, can be calibrated in terms of either force or weight.

<u>**Procedure:**</u>

1. Connections are made as per the circuit diagram.
2. Switch **ON** the supply with no-load on Cantilever.
3. Keep the calibrate knob to maximum position and adjust the **zero** balance Knob, until the display is **zero micro strain.**
4. Load the cantilever beam with 0.1 kg and adjust the calibration knob to display **38** micro

strains. Remove the load and check for **zero** display. This completes strain gauge calibration.

5. Gradually apply the load in steps of 0.1 kg and tabulate the readings of micro strain displayedon the strain measurement kit and the voltmeter readings.
6. Gradually remove the loads and switch **OFF** the supply.
7. Note down the dimensions of cantilever beam and calculate the micro strain for each load.

**Observation Table:**

| Sl.no. | Load (kg) | Calculated value | Indicator reading | Voltage (mv) | % Error = |
|---|---|---|---|---|---|
| | | | | | |

## Specimen calculation for cantilever beam

$$S = (6\,P\,L) / BT^2E$$

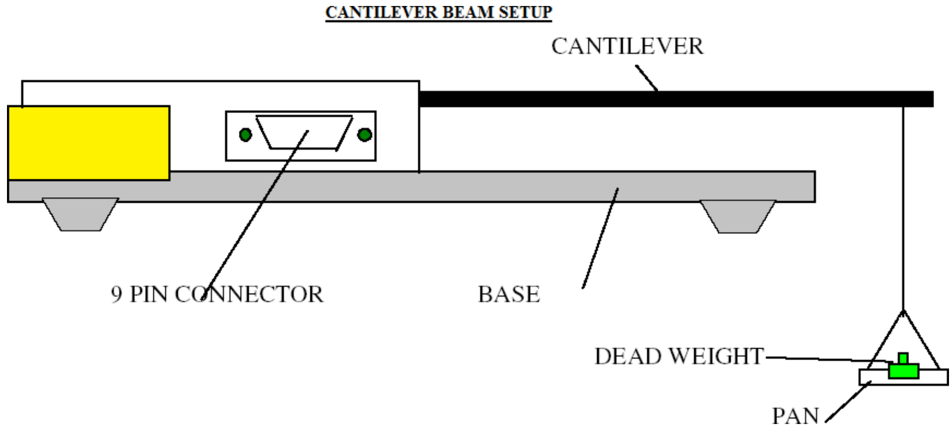
P = Load applied in Kg. ( 1 Kg)
L = Effective length of the beam in Cms. ( 22 Cms)
B = Width of the beam ( 2.8 Cms)
T = Thickness of the beam ( 0.25Cm)
E = Youngs modulus ( $2 \times 10^6$ )
S = Microstrain

Then the microstrain for the above can be calculated as fallows

$$S = \frac{6 \times 1 \times 22}{2.8 \times 0.25^2 \times (2 \times 10^6)}$$

$$S = 3.77 \times 10^{-4}$$

$$S = 377 \text{ microstrain.}$$

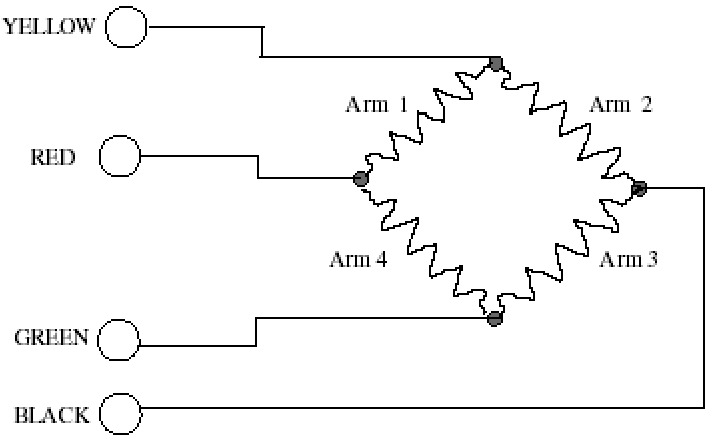



**Physical dimensions:**

Over all BEAM Length (X) : 300 mm

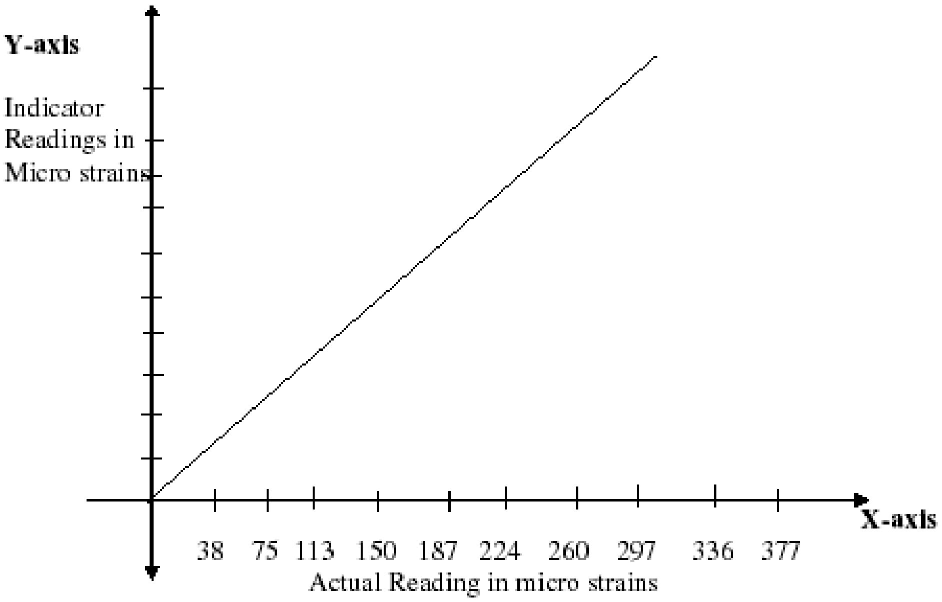
Actual Length (L) : 220.0 mm (Middle of the Strain Gauge Grid to loading point)
Width of the Beam (b) : 28.0 mm

Thickness of the Beam (t) : 2.5 mm

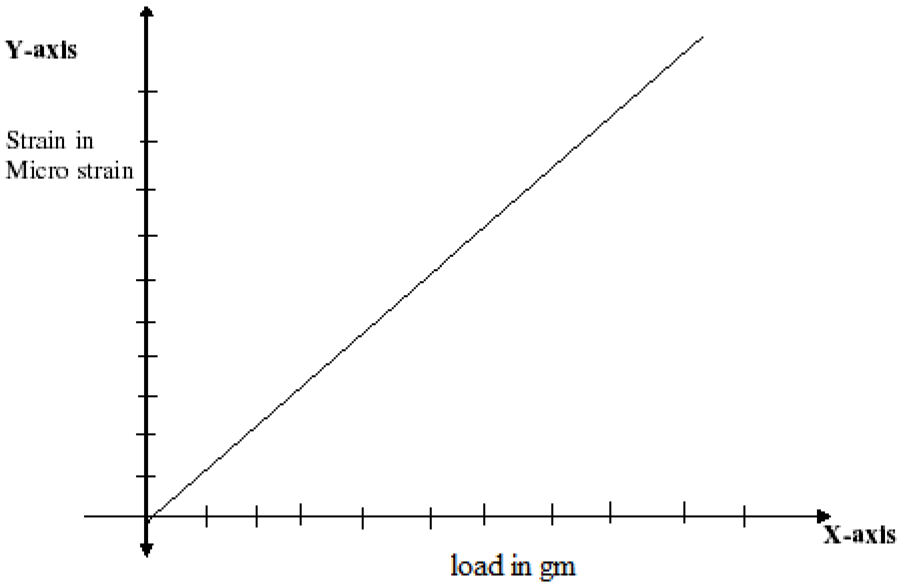



**Graph**: Load (Vs) Display micro strain.

**Graph : Graph Plotted Actual Readings (X-axis) Vs Indicator Readings (Y-axis)**




**Load Vs Strain**




**Viva-Voice:**

**1.** What is the working principle of strain gauge?

2. Which type of transducer is strain gauge?

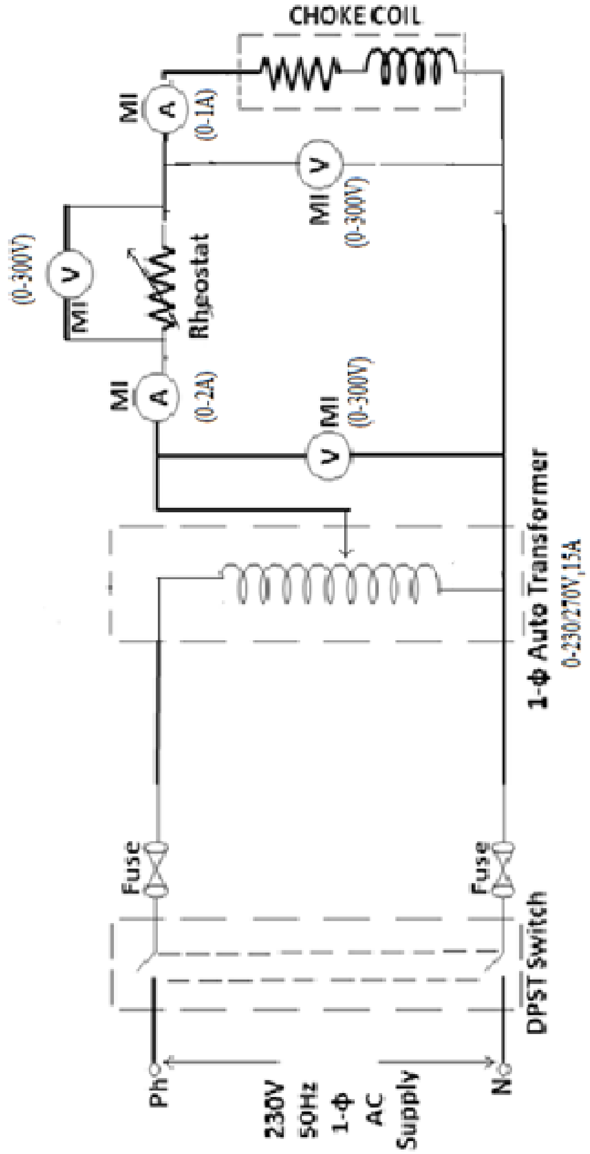
3. What are the advantages of strain gauges?

4. What are the uses of strain gauges?

5. What do we call the combination of gauges?

**Result:**

**Circuit Diagram:**



**Experiment No:** **Date:**

## 12. AC Potentiometer – Polar form/Cartesian form – Calibration of AC Voltmeter, Parameters of Choke

**Aim:** To measure the parameters of the choke coil using 3-voltmeter method

**Apparatus Required:**

| S. No | Name of the Apparatus | Type | Range | Quantity |
|---|---|---|---|---|
| 1 | AUTO TRANSFORMER | VARIAC | (0-230/270V,15A) | 1 No |
| 2 | Voltmeter | MI | (0-300)v | 3 No |
| 3 | Ammeter | MI | (0-2)A | 1 No |
| 4 | Choke coil | -- | -- | 1 No |
| 5 | Rheostat. | -- | (0-360)A | 1 No |
| 6 | Connecting wires | -- | -- | 1 bunch |

**THEORY:** Refer text book by the student

**TABULAR FORMS:**

Observation cum Calculation table for 3 – Voltmeter method:

| S. No | V1 | V2 | V3 | P= $(V_1^2 - V_2^2 - V_3^2)/2R$ | CosΦ= $(V1^2 - V2^2 - V3^2)/2V2V3$ | SinΦ | I= V2/R | Z= V3/I | R= ZcosΦ | $X_L$= ZsinΦ | L= $X_L/2\Pi f$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

Average Inductance = Average Resistance =

**Procedure:**

**1.** Connections are made as per the circuit diagram.

2. Observe the VR,V and VL for the given record these in observation table.

3. Change the load resistance R measure in observation table and record its value in the observation table.

4. Calculate the value of R and record in observation table.

5. Take another set of the calculation of VR,V,VL calculate the power and power factor and tabulate these in observation table.

6. Take at least 3sets of observations of the different values of R calculate power, impedance, resistance and inductance.

**Model Calculations:**

**Calculations for 3-Voltmeter method:**

Supply voltage = $V_1$

Voltage across standard resistance R = $V_2$

Voltage across choke coil = $V_3$

Power consumed by the choke coil P = $(V_1^2 - V_2^2 - V_3^2)/ 2R$

Power factor of the choke coil $\cos\phi = (V_1^2 - V_2^2 - V_3^2) / 2V_2V_3$

Current flowing through the choke coil I = $V_2/ R$

Impedance of the coil (Z) = $V_3/ I$

Resistance of the coil (R) = Z Cosϕ

Reactance of the coil (X) = Z Sinϕ

Induction of the coil (L) = X/2Π

**Precautions:**

**1.** Avoid the loose connections readings are taken without parallax error**.**

**Result:**

**Viva-Voce:**

1. What is inductance?
2. What is formula for inductive reactance?
3. What is formula for capacitive reactance?
4. What is capacitance?
5. What is rating of dimmer stat?
6. What is meant by choke coil?
7. What is the difference between MC & MI instruments?
8. What is resistance?
9. What is meant by power factor?
10. What is power?