DEPARTMENT OF ELECTRICAL ENGINEERING

LAB MANUAL

SUBJECT: EMI

B.TECH -3RD SEM

KCT COLLEGE OF ENGG & TECH

FATEHGARH

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EXPERIMENT NO. 1

AIM: MEASUREMENT OF RESISTANCE USING WHEATSTONE BRIDGE

To measure the given medium resistance using Wheatstone Bridge.

OBJECTIVE:
1. To study the working of bridge under balanced and unbalanced condition.
2. To study the sensitivity of bridge.

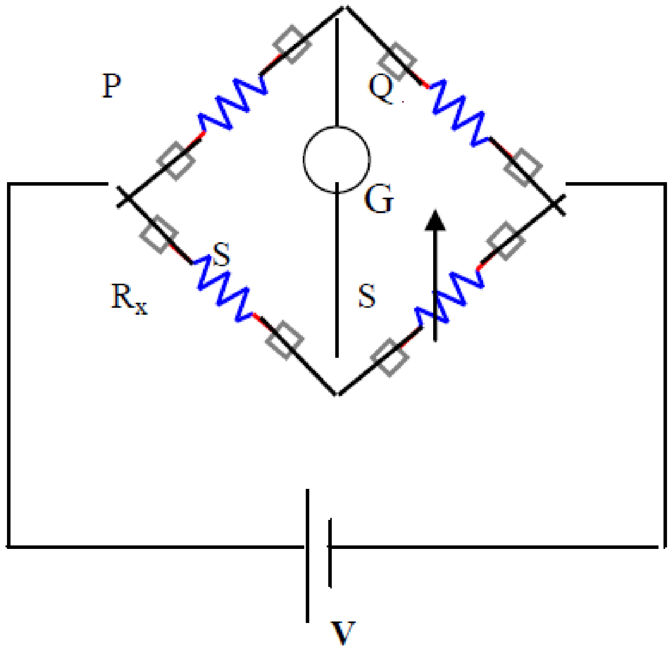
EQUIPMENT:
1. Wheat stone Bridge kit – 1 No
2. Unknown resistance – 1 No
3. Multimeter – 1 No
4. Connecting Wires.

EXERCISE:
1. Design a bridge for the given parameters.
2. Find the unknown resistance.
3. Find the sensitivity of Bridge.

PROCEDURE:
1. The resistance to be measured is connected between XX points in the bridge kit.
2. The P/Q ratio (multiplier) is initially kept at position '1' and the deflection of the galvanometer is observed by Pressing both the battery and the galvanometer keys.
3. The S arm (X□) is adjusted and two positions are identified for which the deflection of 1000 the galvanometer is on Either side of the null point or kept at the lowest value of S. Then the □, x10□, x1□ knobs x100 of S are adjusted to Get null deflection. If necessary the sensitivity knob may be controlled to get appreciable deflection. [If not possible P/Q ratio is kept at suitable value i.e., any one of ratios provided.]
4. The value of unknown resistance is read. (S value)
5. Steps 3 and 4 are repeated for some other P/Q ratio. The mean value is taken.
6. The experiment is repeated with other samples provided.

The above experiment may be used for measuring resistance of the samples less than 1 □ to greater than 10000□ with lesser sensitivity .

CIRCUIT DIAGRAM :



CALCULATION:

Unknown Resistance, Rx = P/Q * S (□)
Where P, Q = Ratio Arms.
S = Variable resistance,
Rx = Unknown resistance.

TABULAR COLUMN:

S.NO	SAMPLE	P/Q RATIO (MULTIPLIER)	S VALUE (Ω)	UNKNOWN RESISTANCE RX (Ω)

EXPERIMENT NO. 2

MEASUREMENT OF RESISTANCE USING KELVIN'S DOUBLE BRIDGE.

AIM: To measure the given low resistance using Kelvin's double bridge method**.**

OBJECTIVE

1. To study the working of bridge under balanced and unbalance condition.
2. To study the sensitivity of bridge.

EQUIPMENT

1. Kelvin Double bridge kit – 1 No
2. Unknown resistance – 1 No
3. Multimeter – 1 No
4. Connecting wires.

FORMULA USED:

Rx = P/Q * S ohms

Where

P,,Q First set of ratio arms.

P,,q Second set of ratio arms.

S Standard resistance,

Rx unknown resistance.

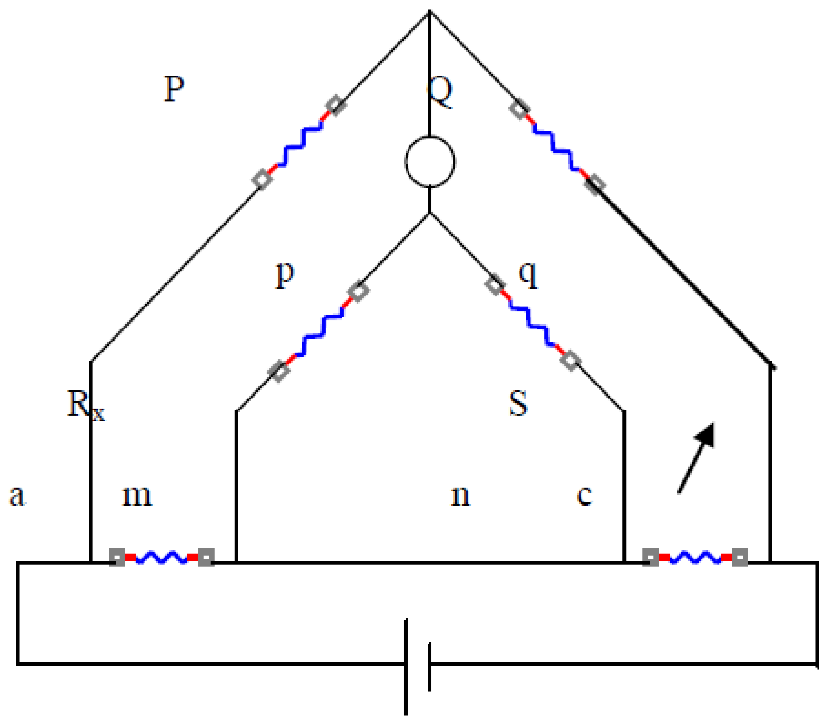
EXERCISE

1. Design a bridge for the given parameters.
2. Find the unknown low resistance.
3. Find the sensitivity of bridge

PROCEDURE:

1. The resistance to be measured is connected such that the leads from +C and + P are connected to one end and those
From –C and –P are connected to the other end in the kit.
2. The P/Q ratio (multiplier) is initially kept at position '1' and the deflection of the galvanometer is observed by
Pressing the galvanometer key.
3. The 'S' arm (main dial) is adjusted and two positions are identified for which the deflection of the galvanometer is
On either side of the null point. [If not some other P/Q ratio is to be tried].
4. The lower of the two positions indicates the coarse value of the unknown resistance and the null point is obtained by
Adjusting the Vernier scale, with the galvanometer sensitivity knob at the maximum position.
5. The value of unknown resistance is read. ['S' Value]
6. Steps 3,4,5 are repeated for some other P/Q ratio for the unknown resistance. The mean value is taken.
7. The above procedure is repeated with another sample.

CIRCUIT DIAGRAM



TABULAR COLUMN:

S.NO	SAMPLE	P/Q RATIO (Multiplier)	S VALUE		UNKNOWN RESISTANC RX (Ω)
			COARSE (Ω)	FINE (Ω	

RESULT:

The value of unknown resistance is found experimentally

EXPERIMENT NO. 3

MEASUREMENT OF CAPACITANCE USING SCHERING BRIDGE.

AIM: To measure the unknown capacitance using Schering bridge.

OBJECTIVE:

1. To measure the unknown capacitance.
2. To study about dissipation factor.

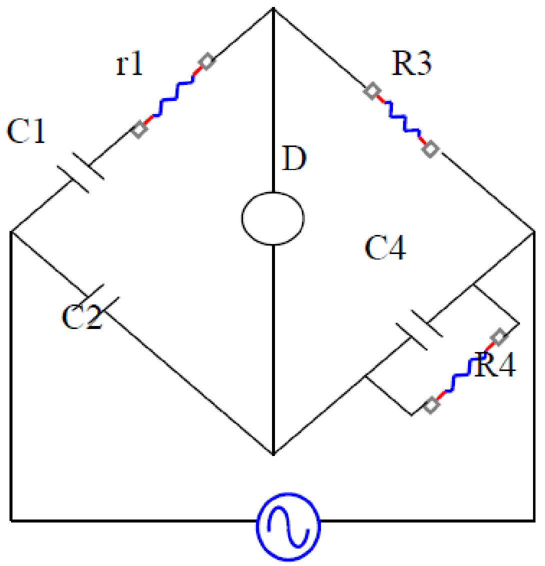
EQUIPMENT:

1. Schering Bridge kit – 1 No
2. Multimeter – 1 No
3. Unknown capacitance – 1 No
4. Connecting wires

PROCEDURE:

1. Connections are given as shown in the circuit diagram.
2. The value of R2 is selected arbitrarily (say1K) and R1 is varied.
3. If the selection of R2 is correct the balance point (NULL POINT) can be observed on the oscilloscope by varying R1.If not another value of R2 is chosen. [At balance the vertical line in the oscilloscope comes to a point for an Particular value of R1 in the same direction.]
4. The capacitor C1 can be varied for fine balance adjustment.
5. When the balance condition is reached, the trainer kit is switched OFF and the value R1 is measured using a multimeter.
6. The value of unknown capacitance is calculated.
7. The experiment is repeated for various samples provided.

CIRCUIT DIAGRAM :



EXERCISE

1. Design a bridge circuit for the given parameters.
2. Find the dissipation factor.
3. Fluid the unknown capacitance.
4. R2 = Non-Inductive Variable Resistor

CALCULATION:

Unknown capacitance, Cx = R1/R2 * C3,
Where C3 = Known Capacitance, Microfarads

TABULAR COLUMN:

S.NO	SAMPLE	R2 (Ω)	R1 (Ω)	UNKNOWN CAPACITANCE (Farads)

RESULT:

The value of unknown capacitance is found experimentally by using the Schering Bridge.
Unknown Capacitance, Cx =

EXPERIMENT NO. 4

Aim : - To measure the self - inductance of a given coil by Anderson's bridge method.

Apparatus :- Inductor, standard capacitor, resistors (fixed resistances and variable pots as given in the circuit) signal generator, head phones and connecting terminals.

Formula :- Inductance of given coil $L = C [(R_1 + R_2) R_5 + R_2 R_4]$ mH

Where C = Capacity of the standard capacitor (μ F)

R_2, R_3, R_4 = Known, fixed and non – inductive resistances (KΩ) R_1, R_5 = Variable resistances (KΩ)

Description :- Anderson's bridge is the most accurate bridge used for the measurement of self – inductance over a wide range of values, from a few micro-Henries to several Henries. In this method the unknown self-inductance is measured in terms of known capacitance and resistances, by comparison. It is a modification of Maxwell's L - C bridge. In this bridge, double balance is obtained by the variation of resistances only, the value of capacitance being fixed.

Procedure :-The circuit diagram of the bridge is as shown in the figure. The coil whose self-inductance is to be determined, is connected in the arm AB, in series with a variable non-inductive resistor R_1. Arms BC, CD and DA contain fixed and non – inductive resistors R_2, R_3 and R_4 respectively. Another non - inductive resistor R_5 is connected in series with a standard capacitor C and this combination is put in parallel with the arm CD. The head - phones are connected between B and E. The signal generator is connected between A and C junctions.

Select one capacitor and one inductor and connect them in appropriate places using patch chords. The signal generator frequency is adjusted to audible range. A perfect balance is obtained by adjusting R_1 and R_5 alternatively till the head – phones indicate a minimum sound. The values of R_1 and R_5 are measured with a multi-meter(While measuring the R_1 and R_5 values, they should be in open circuit).In the balance condition the self – inductance value of the coil is calculated by using the above formula. The experiment is repeated with different values of C.

Precautions : - 1) The product (CR_2R_4) must always be less than L .

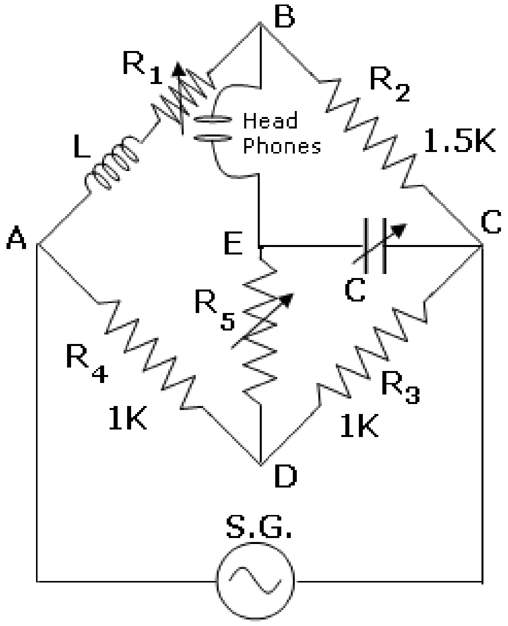
2) R_1 and R_5 are adjusted until a minimum sound is heard in head – phones.

Result :-

____

Table

S.No.	Capacity (C) μ F	Resistance (R_1) Ω	Resistance (R_5) Ω	Calculated value (L) $C [(R_1 + R_2) R_5 + R_2R_4]$ mH	Standard value of L mH
1.					
2.					
3.					
4.					
5.					
6.					


B
R1
R2
Head
Phones
1.5K
L
A
E
C
C
R5
R4
R3
1K
1K
D
S.G.

* * * * *

EXPERIMENT NO. 5

AIM:

To measure active and reactive power in three phase balanced load by one wattmeter method.

PRIOR CONCEPTS:

- Active power, reactive power, power factor in 3 phase circuit.
- 3 phase power system balanced and unbalanced load, phasor diagrams.
- Multiplying factor of wattmeter.

NEW CONCEPTS

Proposition 1 : Measurement of power in 3 phase circuit

Power in 3 phase system may be measured by using

1 Three single phase wattmeter - This method is used for a star connected, 4 wire system, balanced or unbalanced load.

2 Two 1 phase wattmeter - This method is suitable for 3 phase, 3 wire system and widely used.
It is applicable to both delta and star system, balanced or unbalanced load.

3 One single phase wattmeter - This method is applicable to balanced load only.

4 One 3 phase wattmeter - 3 phase wattmeter consists of two or three wattmeter elements mounted together in one case with moving coils mounted on the same spindle

Proposition 2 :

One wattmeter method for measurement of active power is for 3 phase balanced load only. The current coil of the wattmeter is connected in one of the lines and one end of pressure coil is connected to the same line. The readings are taken by connecting other terminal of pressure coil alternately to other 2 lines. The sum of the two readings gives active power.

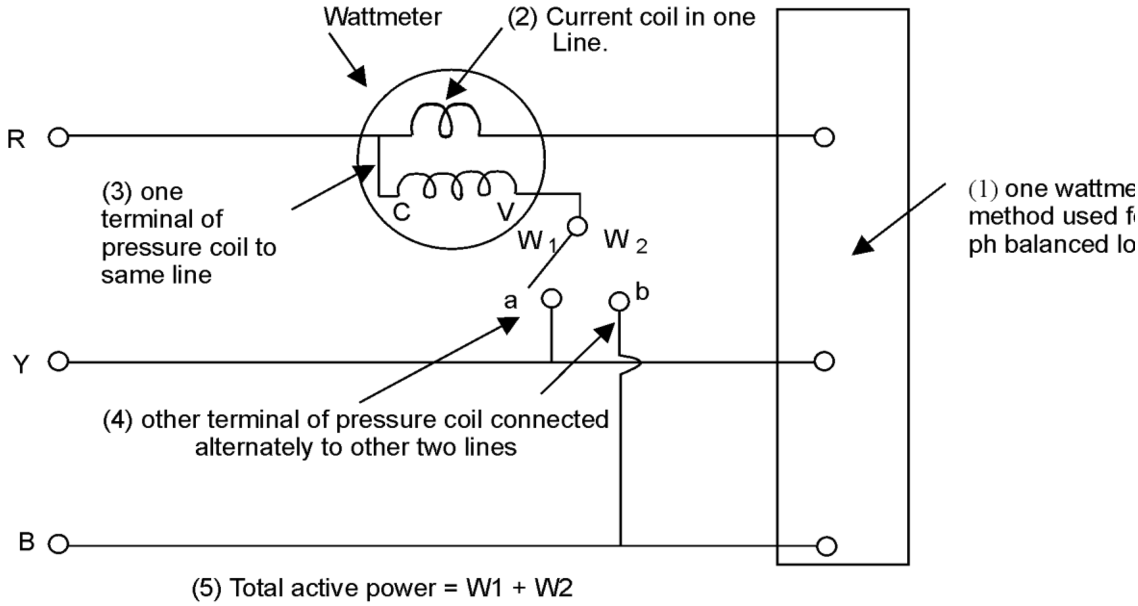


Fig - 2.1 Basic Diagram

Proposition 3 :

It is often convenient and even essential that reactive power be measured. For example in load monitoring, such a measurement gives the operator the information of the nature of load. Also the reactive power serves as a check on power factor measurements, since ratio of reactive and active power is tan f = Q/P Where Q & P are the reactive and active power respectively.

Proposition 4 :

One wattmeter method for measurement of reactive power is for 3 phase balanced load only. The current coil of the wattmeter is connected in one of the lines. The pressure coil is connected across two lines. The reactive power is Ö3 times the wattmeter reading.

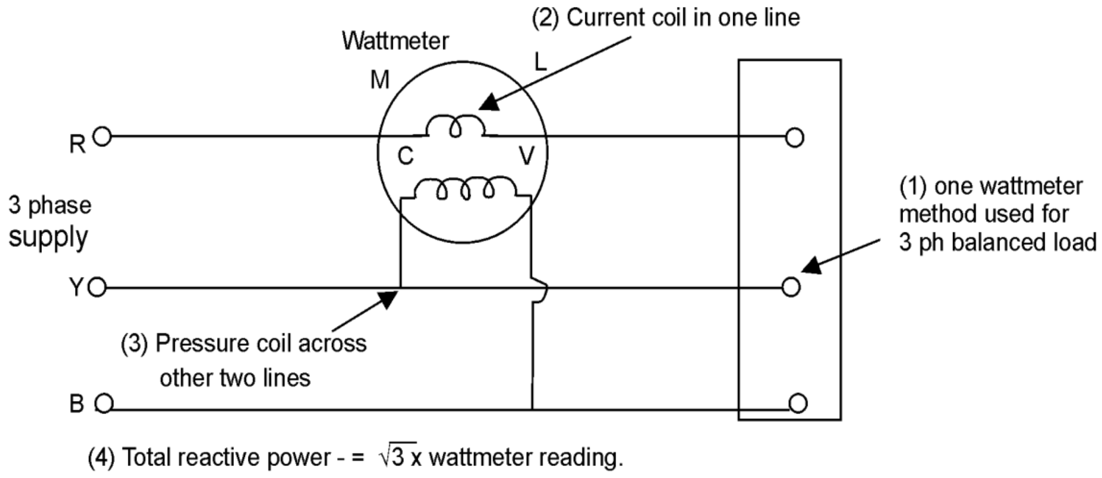


Fig. 2.2 **Basic Diagram.**

LEARNING OBJECTIVES:

Intellectual Skills:

- To understand the significance of reactive power.
- To understand the need of measurement of reactive power.

Motor Skills

- To Handle the wattmeter.
- To operate load and set it for balanced load reading.
- To interchange wattmeter connections if it reads negative.

CIRCUIT DIAGRAM :

Part A

(Students shall draw the circuit diagram in the space provided. The diagram shall include the following things)

- Measurement of active power in 3 phase balanced circuit by one wattmeter method.
- Refer to proposition 2 and draw the circuit diagram.

1 Use 3 phase balanced load (lamp bank or inductive load)

2 Show switch, fuse and meters.

Part B

(Students shall draw the circuit diagram in the space provided. The diagram shall include the following things.)

- Measurement of reactive power in 3 phase circuit by one wattmeter method.
- Refer to proposition 4 and draw the circuit diagram.

1 Use 3 phase balanced load.

2 Show switch, fuse and meters.

APPARATUS :

- 3 phase Variac (0 - 415V)
- A. C. Ammeter (0 - 5A)
- A. C. Voltmeter (0 - 300V)
- Wattmeter (300V, 5A, 625Watts)
- Variable power factor load.

STEPWISE PROCEDURE :

Part A

- Make the connections as per the circuit diagram.
- Check and adjust zero indication of wattmeter and note the multiplying factor of wattmeter.
- Switch on the supply.
- Adjust required amount of supply voltage with variac.
- Adjust balanced load.

- Note voltmeter, ammeter & wattmeter reading W1 with switch at 'a'.
- Note wattmeter reading W2 with the switch at 'b'.
- Take four readings for different current for balanced load.
- Switch off the supply.
- Calculate total active power and power factor.

Part B

- Make the connections as per the circuit diagram.
- Switch on the supply.
- Adjust the same values of current for balanced loads as in part (a).
- Note wattmeter, voltmeter & ammeter reading.
- Switch off the supply.

Observations :

Part A - Measurement of active power

Sr. No.	Voltage V (Volts)	Current I (Amp)	Wattmeter Reading (Watts)	Total Active Power $P = W_1+W_2$	$\tan\phi = \frac{\sqrt{3} \times (W_1 - W_2)}{(W_1 + W_2)}$	Power factor $= \cos\varphi$
1						
2						
3						
4						

EXPERIMENT NO. 6

Aim: Calibration of 1-cp Energy meter (Induction Type).

APPARATUS :-

S.No.	APPARATUS	RANGE	TYPE	QTY	REMARKS
1.	Auto Transformer	230v/0-230v	Continuously variable	1	
2.	Load	5kw	Resistive	1	
3.	1-Φ Energy meter	750rev/kwh	Induction	1	
4.	Voltmeter	(0-3 00v)	M.I	1	
5.	Ammeter	(0-5A)	.	1	
6.	Wattmeter	300v, 5A	M.I	1	
7.	Stop Watch		.	1	

THEORY:

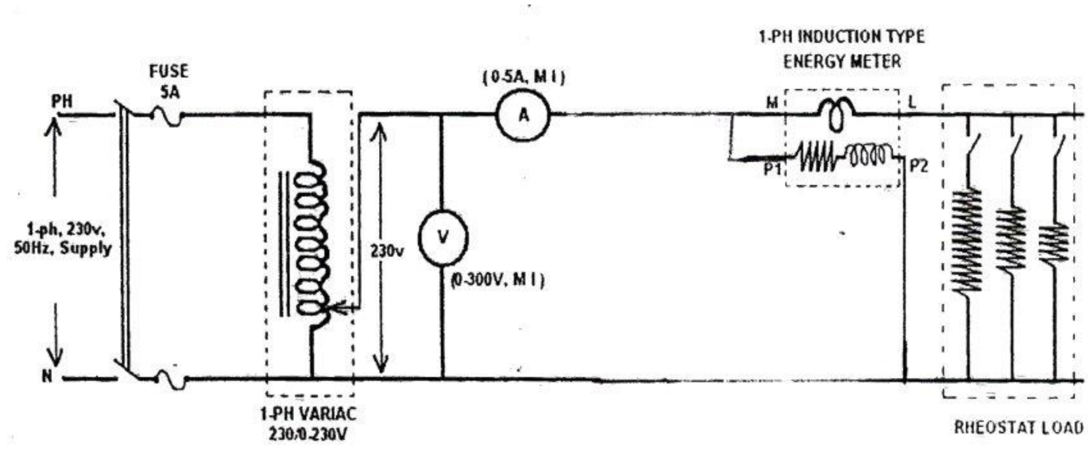
Induction Type Energy meter is widely used for the measurement of energy consumed in domestic as well as in industrial installations. Induction instruments possess lower friction and higher torque/weight ratio. And these instruments cost less and are accurate over a wide range of loads and temperatures.

There are four main parts of the operating mechanism.

(i) Driving System. (ii) Moving System. (iii) Braking System.
(iv) Registering Mechanism.

Principle of Operation: The pressure and current coils of shunt and series magnets produce two alternating fluxes, one proportional to voltage and the other proportional to load currents. These two fluxes when cut the disc induce eddy currents in it. The interaction of the fluxes with the eddy currents sets up a torque on the disc causing it to rotate. The speed of the disc would then be proportional to the power being measured.

CIRCUIT DIAGRAM:



PROCEDURE:-

1. Connect the circuit as shown in figure.
2. By adjusting the autotransformer keep the voltage across the voltmeter in which current should not exceed 2.8A in the ammeter.
3. By using stopwatch measure time for 5 rev of the disc of the energy meter and take the corresponding readings if voltmeter, ammeter and wattmeter.
4. Repeat step-3 until the ammeter reading should not exceed 2.8A
5. Tabulate the above readings and calculate the % error of the energy meter.

TABULAR FORM:

S.NO	V (volts)	I (amp)	W, (watts)	Rev/Sec

CALCULATIONS:

%error of the energy meter=(Wi-W_a)/(W*100)

Where Wi = indicating Power (watt) W_a=Actual

Power (watt)

W_a=KR/t
Where 'R' is No. of revolutions

1 Unit=1 KWH=750rev

=1000*60*60=1200rev
1 rev/sec= 1/1000 x 60 x 60 / 280

K=4800W

RESULT:- The percentage error of the energy meter is

PRECAUTIONS:

(v) Energy meter should not be over loaded.
(vi) Connect the meters with appropriate meters.
(vii) Avoid loose connections to prevent sparks and damage to meters.

EXPERIMENT NO. 7

OBJECTIVE: . Study of C.R.O. Voltage measurement on C.R.O. Current measurement on C.R.O. Frequency measurement on C.R.O. Phase difference measurement on C.R.O.

APPARATUS REQUIRED : Cathode-ray oscilloscope, millimeter, and oscillator.

Theory

INTRODUCTION: The cathode-ray oscilloscope (CRO) is a common laboratory instrument that provides accurate time and amplitude measurements of voltage signals over a wide range of frequencies. Its reliability, stability, and ease of operation make it suitable as a general purpose laboratory instrument. The heart of the CRO is a cathode-ray tube shown schematically in Fig. 1.

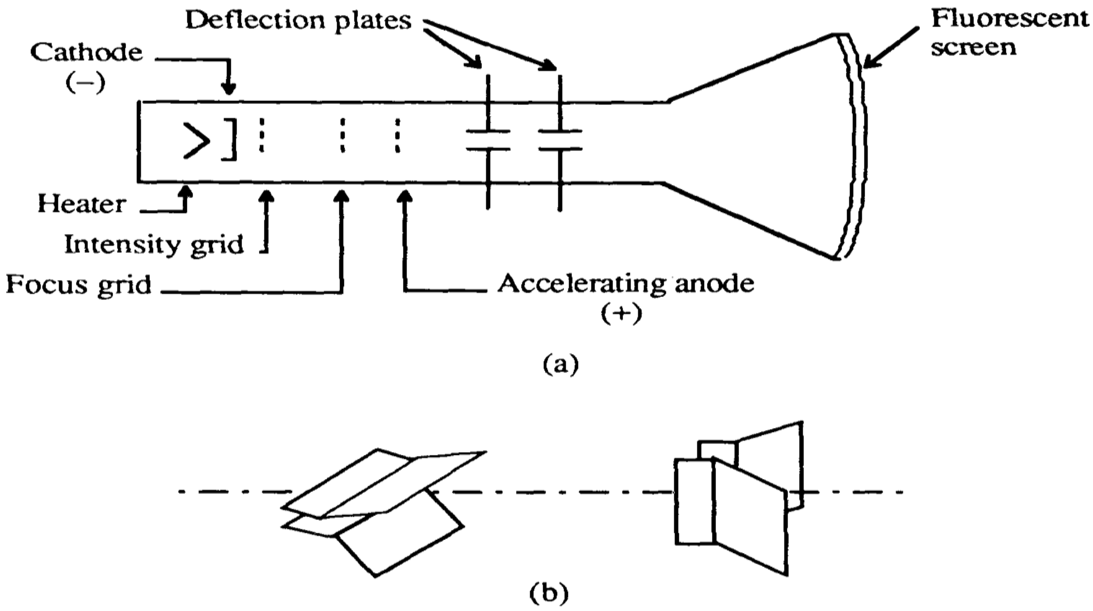


Figure 1. Cathode-ray tube: (a) schematic, (b) detail of the deflection plates.

The cathode ray is a beam of electrons which are emitted by the heated cathode (negative electrode) and accelerated toward the fluorescent screen. The assembly of the cathode, intensity grid, focus grid, and accelerating anode (positive electrode) is called an *electron gun*. Its purpose is to generate the electron beam and control its intensity and focus. Between the electron gun and the fluorescent screen are two pair of metal plates - one oriented to provide horizontal deflection of the beam and one pair oriented ot give vertical deflection to the beam.

These plates are thus referred to as the *horizontal* and *vertical deflection plates*. The combination of these two deflections allows the beam to reach any portion of the fluorescent screen. Wherever the electron beam hits the screen, the phosphor is excited and light is emitted from that point. This coversion of electron energy into light allows us to write with points or lines of light on an otherwise darkened screen.

In the most common use of the oscilloscope the signal to be studied is first amplified and then applied to the vertical (deflection) plates to deflect the beam vertically and at the same time a voltage that increases linearly with time is applied to the horizontal (deflection) plates thus causing the beam to be deflected horizontally at a uniform (constant> rate. The signal applied to the verical plates is thus displayed on the screen as a function of time. The horizontal axis serves as a uniform time scale.

CRO Operation: A simplified block diagram of a typical oscilloscope is shown in Fig. 3. In general, the instrument is operated in the following manner. The signal to be displayed is amplified by the vertical amplifier and applied to the verical deflection plates of the CRT. A portion of the signal in the vertical amplifier is applied to the **sweep trigger** as a triggering signal. The sweep trigger then generates a pulse coincident with a selected point in the cycle of the triggering signal. This pulse turns on the sweep generator, initiating the sawtooth wave form. The sawtooth wave is amplified by the horizontal amplifier and applied to the horizontal deflection plates. Usually, additional provisions signal are made for appliying an external triggering signal or utilizing the 60 Hz line for triggering. Also the sweep generator may be bypassed and an external signal applied directly to the horizontal amplifier.

CRO Contro; The controls available on most oscilloscopes provide a wide range of operating conditions and thus make the instrument especially versatile. Since many of these controls are common to most oscilloscopes a brief description of them follows.

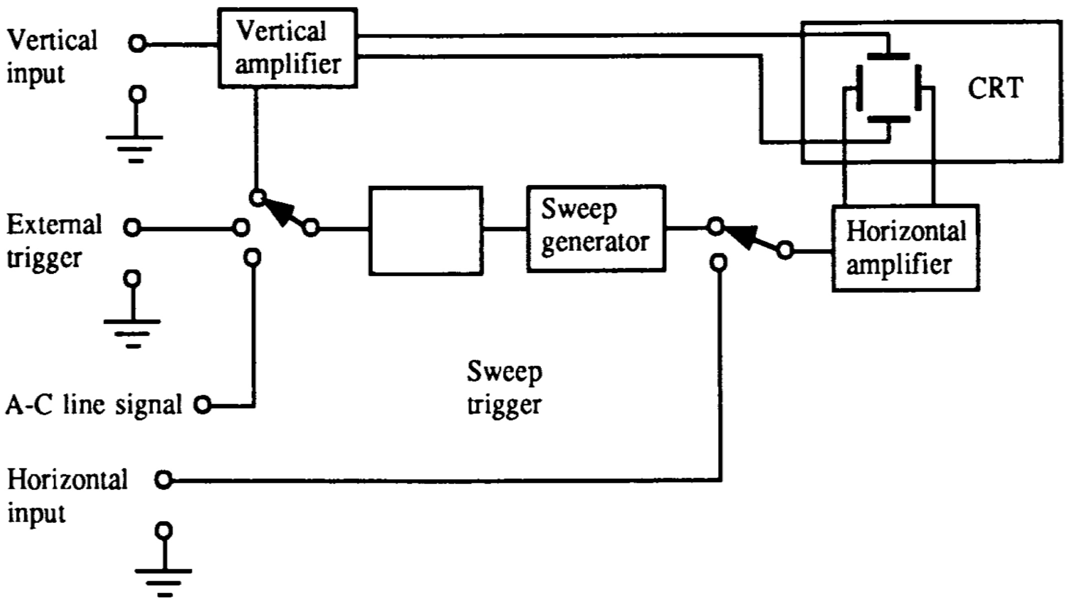


Figure 3. Block diagram of a typical oscilloscope.

CATHODE-RAY TUBE

Power and Scale Illumination: Turns instrument on and controls illumination of the graticule. Focus: Focus the spot or trace on the screen.

Intensity: Regulates the brightness of the spot or trace.

VERTICAL AMPLIFIER SECTION

Position: Controls vertical positioning of oscilloscope display.

Sensitivity: Selects the sensitivity of the vertical amplifier in calibrated steps.

Variable Sensitivity: Provides a continuous range of sensitivities between the calibrated steps. Normally the sensitivity is calibrated only when the variable knob is in the fully clockwise position.

AC-DC-GND: Selects desired coupling (ac or dc) for incoming signal applied to vertical amplifier, or grounds the amplifier input. Selecting dc couples the input directly to the amplifier; selecting ac
send the signal through a capacitor before going to the amplifier thus blocking any constant component.

CONNECTIONS FOR THE OSCILLOSCOPE

Vertical Input: A pair of jacks for connecting the signal under study to the Y (or vertical) amplifier. The lower jack is grounded to the case.

Horizontal Input: A pair of jacks for connecting an external signal to the horizontal amplifier. The lower terminal is graounted to the case of the oscilloscope.

External Tigger Input: Input connector for external trigger signal.

Cal. Out: Provides amplitude calibrated square waves of 25 and 500 millivolts for use in calibrating the gain of the amplifiers.

Accuracy of the vertical deflection is + 3%. Sensitivity is variable.

Horizontal sweep should be accurate to within 3%. Range of sweep is variable.

Operating Instructions: Before plugging the oscilloscope into a wall receptacle, set the controls as follows:

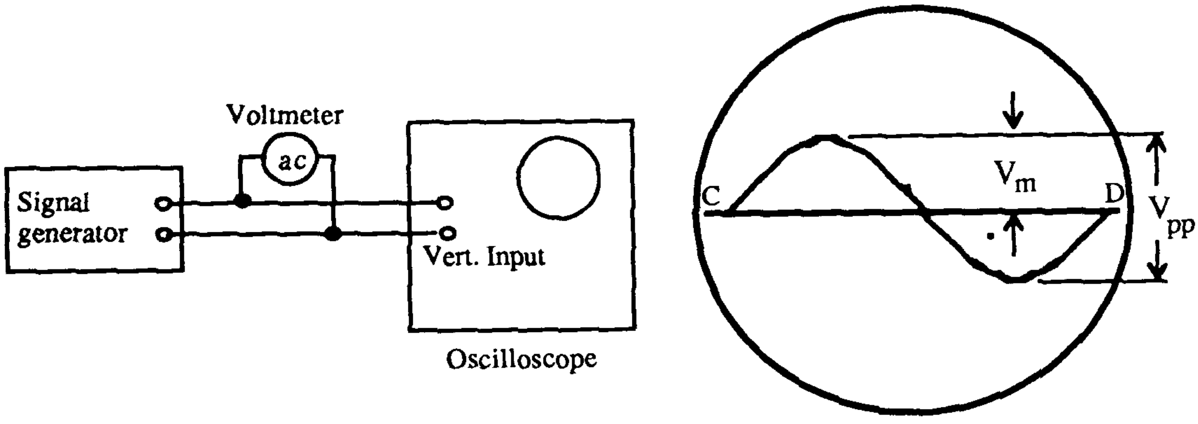
(a) Power switch at off
(b) Intensity fully counter clockwise
(c) Vertical centering in the center of range
(d) Horizontal centering in the center of range
(e)
Vertica
l at 0.2
(f)
Sweep
times 1

Plug line cord into a standard ac wall receptacle (nominally 118 V). Turn power on. Do not advance the Intensity Control.Allow the scope to warm up for approximately two minutes, then turn the Intensity Control until the beam is visible on the screen.

PROCEDURE:

I. Set the signal generator to a frequency of 1000 cycles per second. Connect the output from the generator to the vertical input of the oscilloscope. Establish a steady trace of this input signal on the scope. Adjust (play with) *all* of the scope and signal generator controls until you become familiar with the function of each. The purpose for such "playing" is to allow the student to
become so familiar with the oscilloscope that it becomes an aid (tool) in making measurements in other experiments and not as a formidable obstacle. Note: If the vertical gain is set too low, it may not be possible to obtain a steady trace.

II. Measurements of Voltage: Consider the circuit in Fig. 4(a). The signal generator is used to produce a 1000 hertz sine wave. The AC voltmeter and the leads to the vertical input of the oscilloscope are connected across the generator's output. By adjusting the Horizontal Sweep time/cm and trigger, a steady trace of the sine wave may be displayed on the screen. The trace represents a plot of voltage vs. time, where the vertical deflection of the trace about the line of symmetry CD is proportional to the magnitude of the voltage at any instant of time.



(a) (b)

Figure 4 (a) Circuit for procedure II. (b) Trace seen on scope.

To determine the size of the voltage signal appearing at the output of terminals of the signal generator, an AC (Alternating Current) voltmeter is connected in parallel across these terminals (Fig. 4a). The AC voltmeter is designed to read the dc "effective value" of the voltage. This effective value is also known as the "Root Mean Square value" (RMS) value of the voltage.

The peak or maximum voltage seen on the scope face (Fig. 4b) is V_m volts and is represented by the distance from the symmetry line CD to the maximum deflection. The relationship between the magnitude of the peak voltage displayed on the scope and the effective or RMS voltage (V_{RMS}) read on the AC voltmeter is

$V_{RMS} = 0.707\ V_m$ (for a sine or cosine wave). Thus

$$V_m = \frac{V_{RMS}}{0.707}$$

Agreement is expected between the voltage reading of the multimeter and that of the oscilloscope. For a symmetric wave (sine or cosine) the value of $V_m$may be taken as 1/2 the peak to peak signal V_{pp}

The variable sensitivity control a signal may be used to adjust the display to fill a concenient range of the scope face. In this position, the trace is no longer calibrated so that you can not just read the size of the signal by counting the number of divisions and multiplying by the scale factor. However, you can figure out what the new calibration is an use it as long as the variable control remains unchanged.

Caution: The mathematical prescription given for RMS signals is valid only for sinusoidal signals. The meter will not indicate the correct voltage when used to measure non-sinusoidal signals.

III. Frequency Measurements: When the horizontal sweep voltage is applied, voltage measurements can still be taken from the vertical deflection. Moreover, the signal is displayed as a function of time. If the time base (i.e. sweep) is calibrated, such measurements as pulse duration or signal period can be made. *Frequencies*can then be determined as reciprocal of the periods.

Set the oscillator to 1000 Hz. Display the signal on the CRO and measure the period of the oscillations. Use the horizontal distance between two points such as C to D in Fig. 4b.

Set the horizontal gain so that only one complete wave form is displayed.

Then reset the horizontal until 5 waves are seen. Keep the time base control in a calibrated position. Measure the distance (and hence time) for 5 complete cycles and calculate the frequency from this measurement. Compare you result with the value determined above.

Repeat your measurements for other frequencies of 150 Hz, 5 kHz, 50 kHz as set on the signal generator.

IV. Lissajous Figures: When sine-wave signals of different frequencies are input to the horizontal and vertical amplifiers a stationary pattern is formed on the CRT when the ratio of the two

frequencies is an intergral fraction such as 1/2, 2/3, 4/3, 1/5, etc. These stationary patterns are known as *Lissajous figures* and can be used for comparison measurement of frequencies.

Use two oscillators to generate some simple Lissajous figures like those shown in Fig. 5. You will find it difficult to maintain the Lissajous figures in a fixed configuration because the two oscillators are not phase and frequency locked. Their frequencies and phase drift slowly causing the two different signals to change slightly with respect to each other.

V. Testing what you have learned: Your instructor will provide you with a small oscillator circuit. Examine the input to the circuit and output of the circuit using your oscilloscope. Measure such quantities as the voltage and frequence of the signals. Specify if they are sinusoidal or of some other wave character. If square wave, measure the frequency of the wave. Also, for square waves, measure the on time (when the voltage is high) and off time (when it is low).

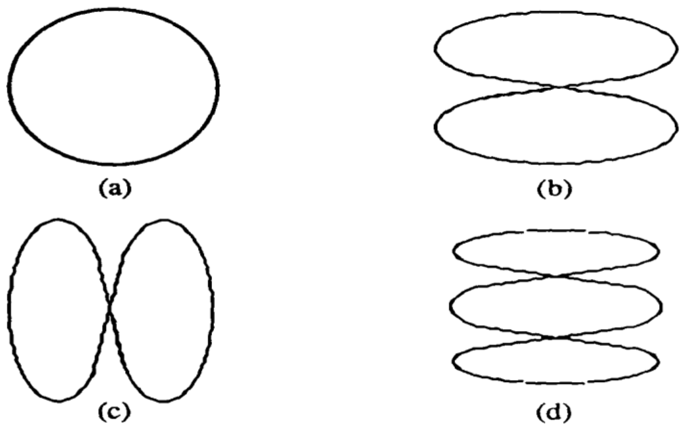


Figure 5. Lissajous figures for horizontal-to-vertical frequency ratios of: (a) 1:1, (b) 2:1, (c) 1:2, and (d) 3:1.

Result:- Study is completed

Precautions: 1.Operate cro carefully

2.Take all reading carefully

3.Use correct power supply

EXPERIMENT NO.8

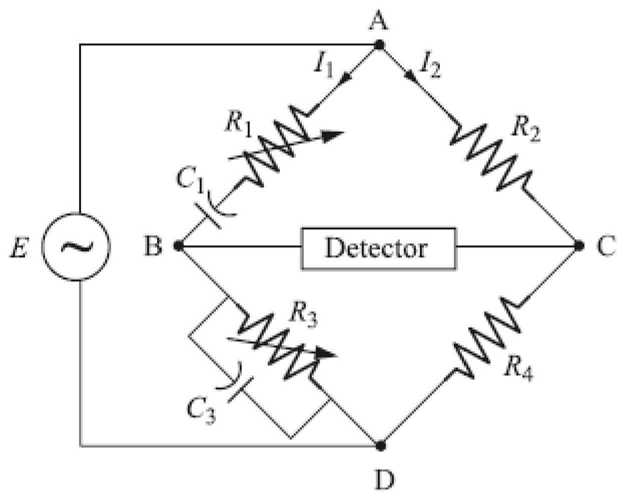
Experiment Name: To measure frequency by Wien's bridge

Apparatus Required:

1. Wien`s Bridge Trainer
2. Multi meter
3. 2mm Patch cords

Theory:

In this bridge circuit, there is a lead-lag network. Balancing of the bridge is easier because satisfying the phase angle equality condition can be achieved. This bridge can also be used to determine the frequency of the AC input in terms of the component values of the bridge circuit. In this AC bridge, there is no inductor. Inductive losses because of stray fields cause problems in balancing of the bridge. Owing to the absence of L in the circuit, this can be effectively used for determining the frequency f of the AC input..



Procedure:

1. Connect mains cord to the Trainer.

2. Connect terminal 1 to 4(for evaluating unknown capacitance Cx1).

3. Rotate variable resistance R1 towards anti clockwise direction.

4. Select Frequency Selector f or any desired range of frequency.

· 100 Hz to 1 kHz

· 1 kHz to 10 kHz

· 10 kHz to 60 kHz

7. For example 2 kHz frequency, select frequency select or between the ranges1 kHz-10 kHz.

8. Use Frequency Variable knob to set 2 kHz frequency on display screen.

9. Connect terminal 19 to 6 and 20 to 7.

10. Now switch ‘On’ the power supply.

11. Set toggle of null detector towards ‘on’ condition.

12. Vary Amplitude Variable f or enough sound of speaker.

13. Vary resistance R1 towards clockwise direction slowly. (Sound diminishes). Keep varying R1 until you get very low sound or null sound (null condition).

16. Now remove the patch cord between terminal 1 & 4 and record the value of R1 in the observation table using multimeter.

Observation Table:

S No.	R1	R2	C1	C2	f
1					
2					
3					
4					
5					

Calculations:

$$f = \frac{1}{2\pi\sqrt{R_1R_3C_1C_3}}$$

Precaution:

1. Handle all the equipments with care
2. Make connections according to circuit diagram
3. Take the readings carefully& the connections should be tight