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SECTION A

REG NO 17PWELE5074

EMI LAB REPORT

ELECTRICAL ENGINEERING (POWER)

UET PESHAWAR

LAB #01:

To find the unknown capacitance using three voltmeters Method.

APPARATUS:

Auto transformer, rheostat, voltmeter capacitor and wires.

THEORY:

THREE VOLTMETERS METHOD:-

This technique is use to find the unknown capacitance of capacitor. In order to measure capacitance using this technique we require three voltages i-e VR, Vc and Vs, so we use uses three voltmeters so therefore this technique is called three voltmeters method.

Ideally voltage across the capacitor lags behind the ~~voltag~~ current by an angle of 90°. But ideally there will be some resistance of capacitor so this angle will be less than 90°

Auto transformer has one winding and a portion of which is use for primary and secondary coil. It can step up and step down the given voltage.

Rheostate is a variable resistor.

PROCEDURE:

The circuit is designed according to the circuit diagram.

I determine VR Vs and Vc with the help of voltmeters.

To draw the diagram select a Suitable scale. Draw VR along the reference axis i-e I. At the tail of VR place compass needle and draw an arc of lenght Vc. At the head of VR place the compass and make an arc of ~~Vs~~ length Vs

Find the angle b/w reference axis and Vc.

Put value of θ in the formula so we obtain the value of capacitance C.

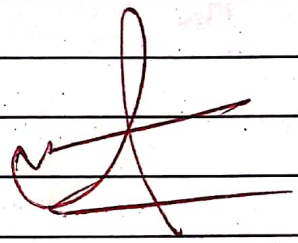
PRECAUTIONS:

The circuit must be accordance with the circuit diagram.

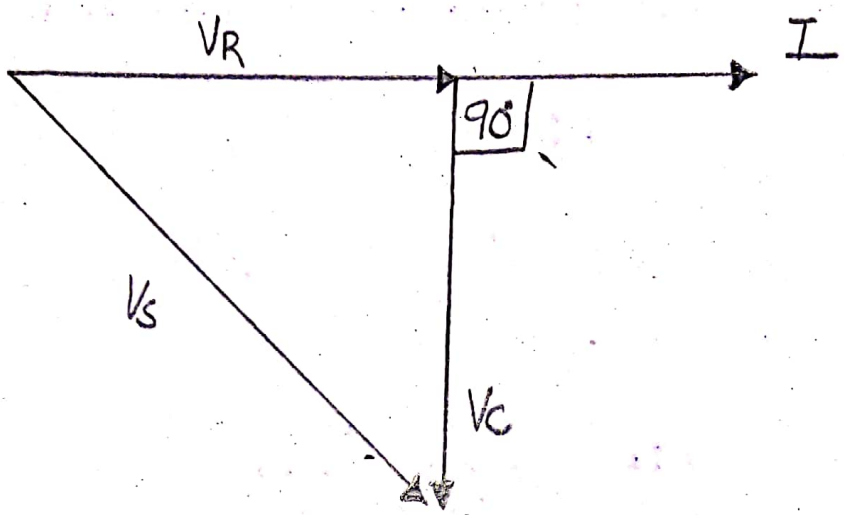
Connections must be tight

Select a proper scale.

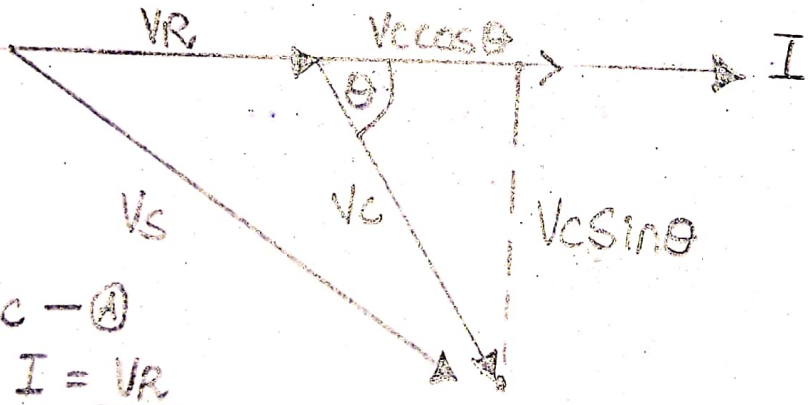
Take readings carefully.



According to KVL: $V_S = V_R + V_C$ (phasor sum)



Practically due to some resistance of capacitor the angle b/w Vc & I will be less than 90°

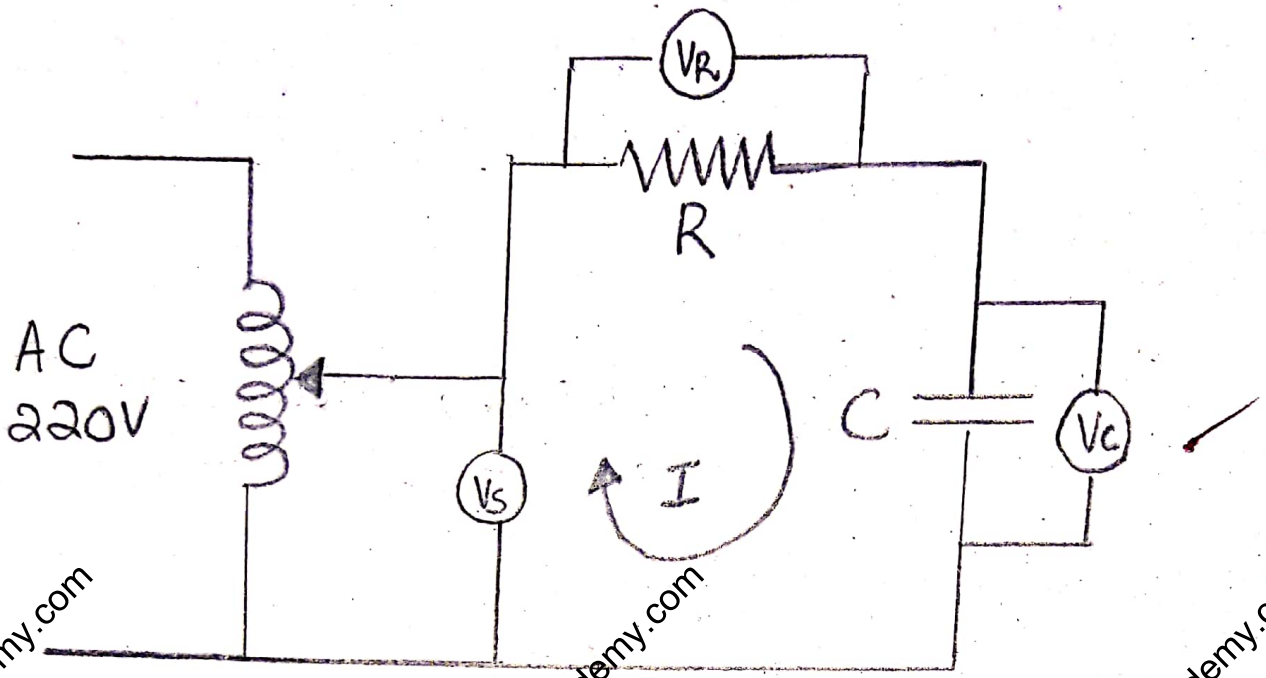


$V_C \sin\theta = I \cdot X_C$ — (1)

$V_R = I \cdot R \Rightarrow I = \frac{V_R}{R}$

$X_C = \frac{1}{\omega C}$

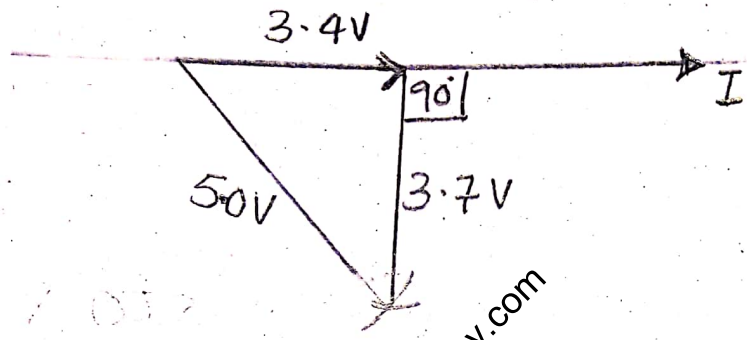
$V_C \sin\theta = \frac{V_R}{R} \cdot \frac{1}{2\pi f C} \Rightarrow$ $\boxed{C = \frac{V_R}{V_C \sin\theta \cdot R \cdot 2\pi f}}$

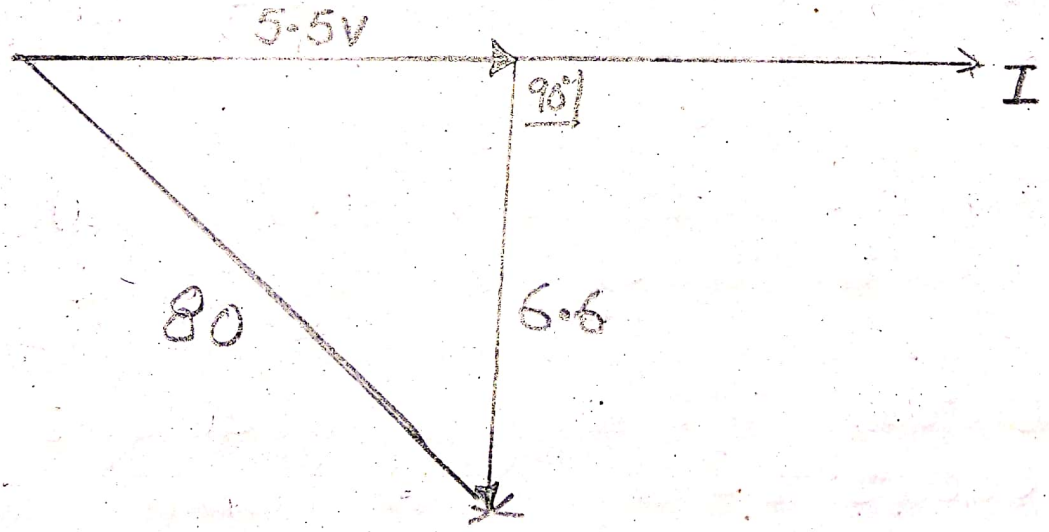


Sr No	VS(V)	VR(V)	VC(V)	θ	C	ERROR
1	50	34.07	37.7	90°	10UF	0
2	80	54.6	60.3	90°	10UF	0
3	100	68.5	75.4	90°	10UF	0

Scale

1cm = 10 V





LAB # 02:

To measure unknown inductance using three voltmeter method.

APPARATUS:

Auto transformer, rheostat, voltmeter, inductor and wires.

THEORY:

In this experiment we find the unknown inductance using three voltmeter method. This is called three voltmeter method because we uses three voltmeters in order to find out the unknown inductance.

In ideal condition the voltage across inductor leads behind the current by an angle of 90°. In practical situation there is some resistance of inductor due to which this angle is less than 90°.

We draw phasor diagram for the circuit shown in fig. We calculate θ in phasor diagram and put θ in formula (1) to called inductance.

PROCEDURE:

The circuit is designed according to the circuit diagram.

I determined V_R, V_S and V_L with the help of voltmeters

To draw diagram select a suitable scale. Draw V_R along the reference axis i.e I. At the tail of V_R place the compass needle and draw an arc of length V_L. At the head of V_R place the compass and make an arc of V_S.

Find the angle b/w reference axis and V_L. Put value of θ in formula to get the inductance L.

$$L = \frac{V_L \sin\theta \cdot R}{2\pi f V_R}$$

PRECAUTIONS:

The circuit must be accordance with the circuit diagram

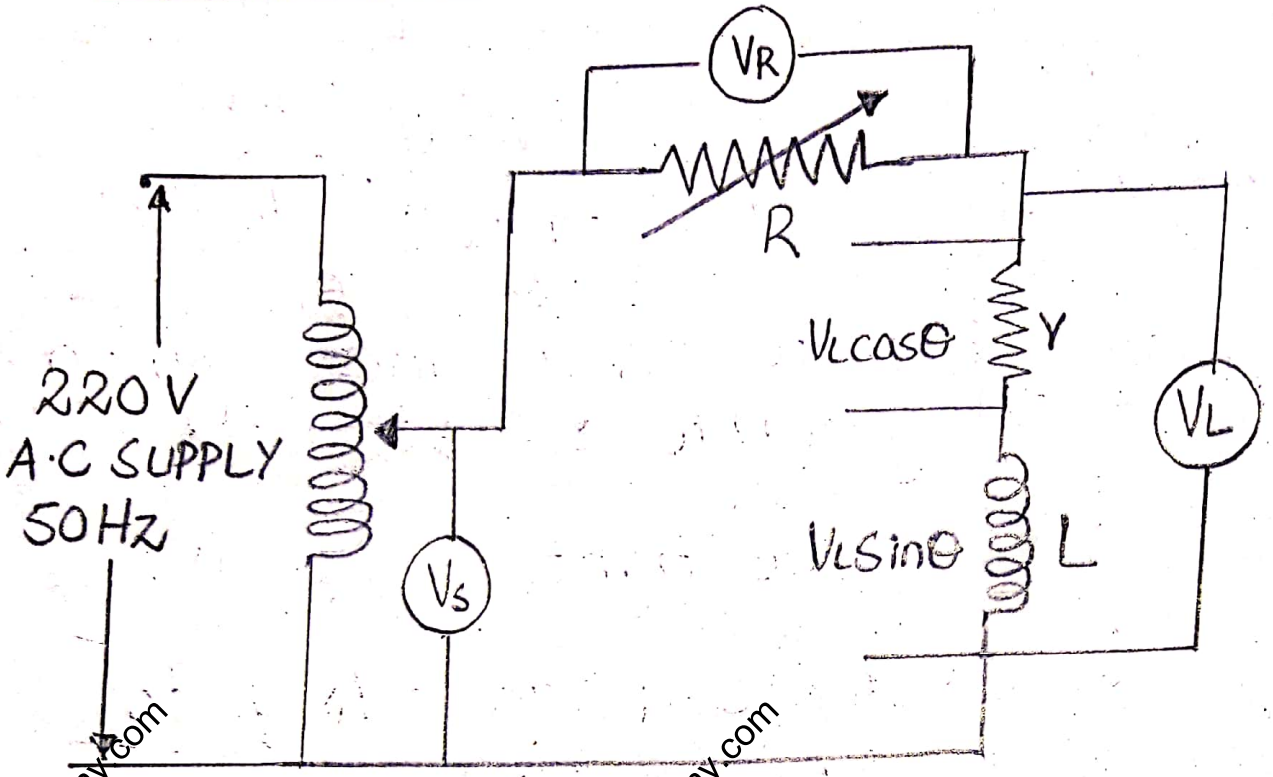
Connects must be tight.

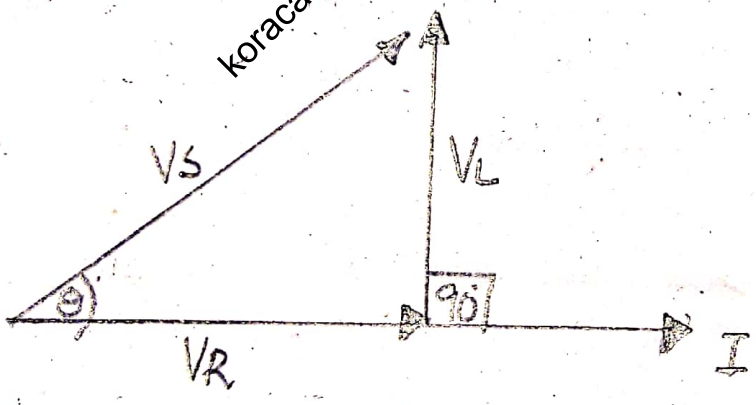
Note the readings of voltmeter accurately.

CONCLUSION:

I concluded from this experiment that we can find the unknown inductance. (L)

CIRCUIT DIAGRAM:





IDEAL CONDITION WHEN Y = 0

$$V_L = I X_L$$

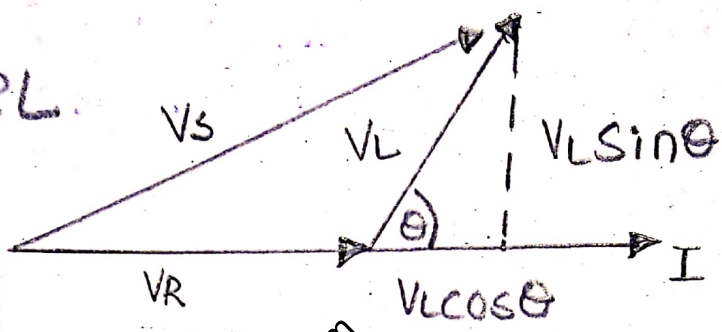
$$V_L = I 2\pi f L = \frac{V_R}{R} 2\pi f L$$

$$\Rightarrow \boxed{L = \frac{V_L R}{2\pi f V_R}}$$

Practically $r \neq 0$:

$$V_L \sin\theta = I X_L$$

$$V_L \sin\theta = \frac{V_R}{R} 2\pi f L$$



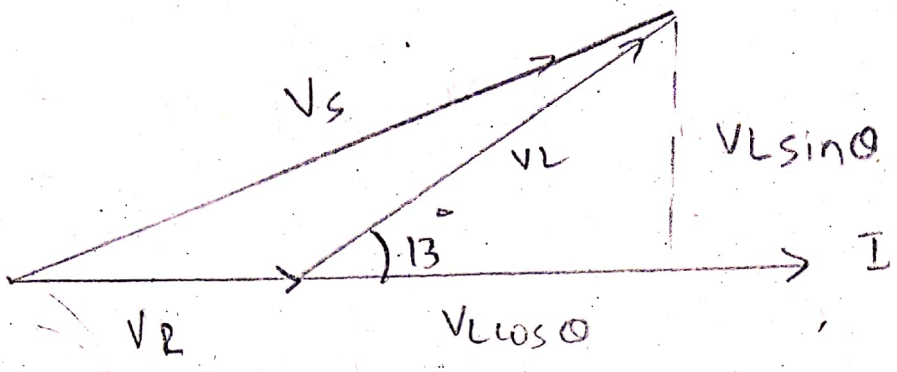
$$L = \frac{V_L \sin\theta \cdot R}{2\pi f V_R}$$

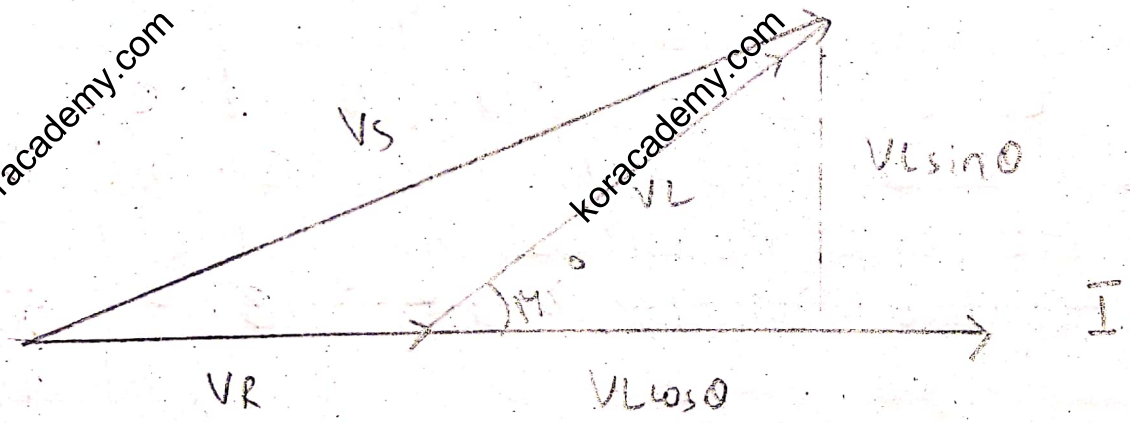
S No	V_S(V)	V_R(V)	V_L(V)	θ°	R	L_m (H)	L_t (H)	$E = L_m - L_t$	%RSE
1	8.25	3.1	5.2	13°	177	0.11	0.1	0.01	10%
2	10.2	3.81	6.42	9°	11	0.13	11	0.03	30%
3	11.7	4.3	7.5	14°	1k	0.4	1	0.07	40%

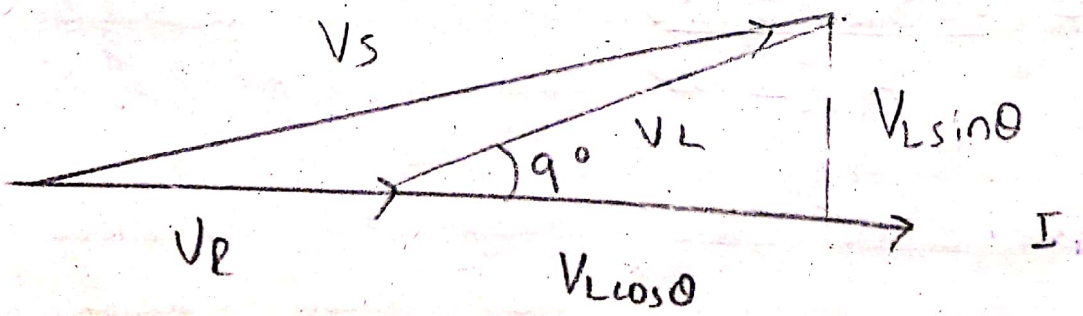
Scale :-

1V = 1cm

10V = 10cm







LAB # 03:-

To learn some useful functions of calculator.

THEORY:

In this lab we learn about different functions of calculator.

1) Constants
2) Table generation
3) Unit conversion
4) Equation solving
5) Matrix
6) STAT (Statistics)

CONSTANT:

We can find the value of any constant using calculator. To find the value of constant press shift (+) 7 Then see in table that you want to calculate the value of which constant write number of that constant and press equal.

TABLE GENERATION:-

We can use calculator for table generation. To generate table in calculator press mode (+) 7

Then Starting value, Ending value and step size.

Equation Solving:-

Solving Equation is possible with the equation solver in calculators. Once the equation has been entered, the calculator uses the Newton-Raphson numerical method to solve the equation. Because the equation solver uses a numerical method, it only works with equations with a single variable.

For example:- $\frac{x^2 - 6}{x+3} = 10$

Shift-solve to enter equation solve by pressing SHIFT CALC. Solve for X will be shown on screen.

STAT:

To perform statistical solution/ calculation we have to enter STAT mode by pressing mode 3. Then we select type of function by pressing any key

To input data perform the following key operation shift [1] on stat mode by pressing mode 3 then we select type of function by pressing any key.

To input data perform the following key operation shift [1] on (STAT) [2] (Data) For L.R of two variable when we input the data then to obtain statistical value we need to press AC then shift [1] (STAT)

[3] to find sum which we need 1 to 8.

[4] Number of item n mean $\bar{x}$, Sn (S.D)

[5] Regression co-efficient.

[6] Min value and Max value

Step are STAT mode
Shift + MODE
STAT press 4
Press [1] for ON MOD(STAT) 3

BASE - N:

To use different type of numbering system and its its conversion and other calculations mode Base-N is used

For Base-N press
[Mode - 4 (Base-N)]

e.g Press DEC (104) it convert into Hex (00000068) oct (000000150) BIN (0000000001101000)

FOR MATRIX:

we can find the matrix value by pressing mode-6

e.g $A = \begin{bmatrix} 2 & 3 \\ 2 & 5 \end{bmatrix}$ $B \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$

First press MatA and then Choose 5 (2x2) put values of A then shift 4 and 2(data) so data will be save in matA then press MATB and choose 5(2x2) put value of B.

LAB #04:

To measure the single phase power using three voltmeter method.

APPARATUS:

Auto transformer
Rheostate
Voltmeters
Load
Connecting wires.

THEORY:

In this experiment we learn that how we uses three voltmeter method to find power absorbed/consumed by the load. We uses three voltmeter in this experiment.

$$V_S^2 = V_L^2 \sin^2\theta + (V_R + V_L\cos\theta)^2$$

$$V_S^2 = V_L^2 \sin^2\theta + V_R^2 + V_L^2\cos^2\theta + 2V_R V_L \cos\theta$$

$$V_S^2 = V_L^2 (\sin^2\theta + \cos^2\theta) + V_R^2 + 2V_R V_L \cos\theta$$

$$V_S^2 - V_L^2 - V_R^2 = 2V_R V_L \cos\theta$$

$$\Rightarrow \cos\theta = \frac{V_S^2 - V_L^2 - V_R^2}{2V_R V_L}$$

Husnain

$$P = V_L I \cos\theta$$

$$P = V_L \left(\frac{V_R}{R}\right) \left(\frac{V_S^2 - V_L^2 - V_R^2}{2 V_R V_L}\right)$$

$$\boxed{P = \frac{V_S^2 - V_L^2 - V_R^2}{2R}} \quad \text{---} (1)$$

PROCEDURE:

I made the circuit according to the circuit diagram. I note the values of V_S, V_L and V_R. I put these values in eq 1 to calculate the power absorbed by the load

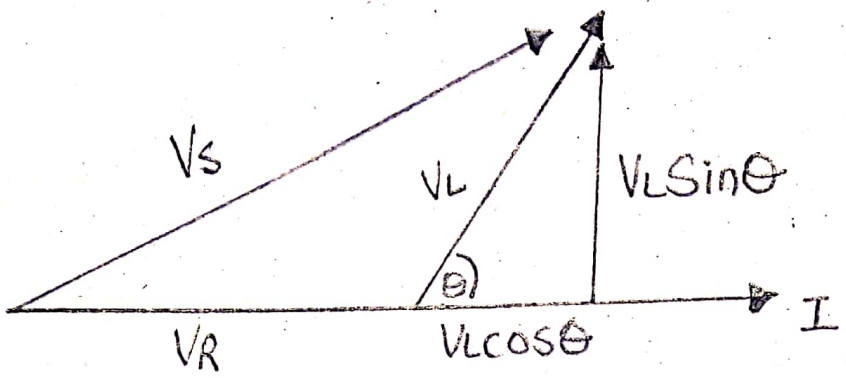
PRECAUTIONS:

Connections must be tight and in accordance with the circuit diagram.

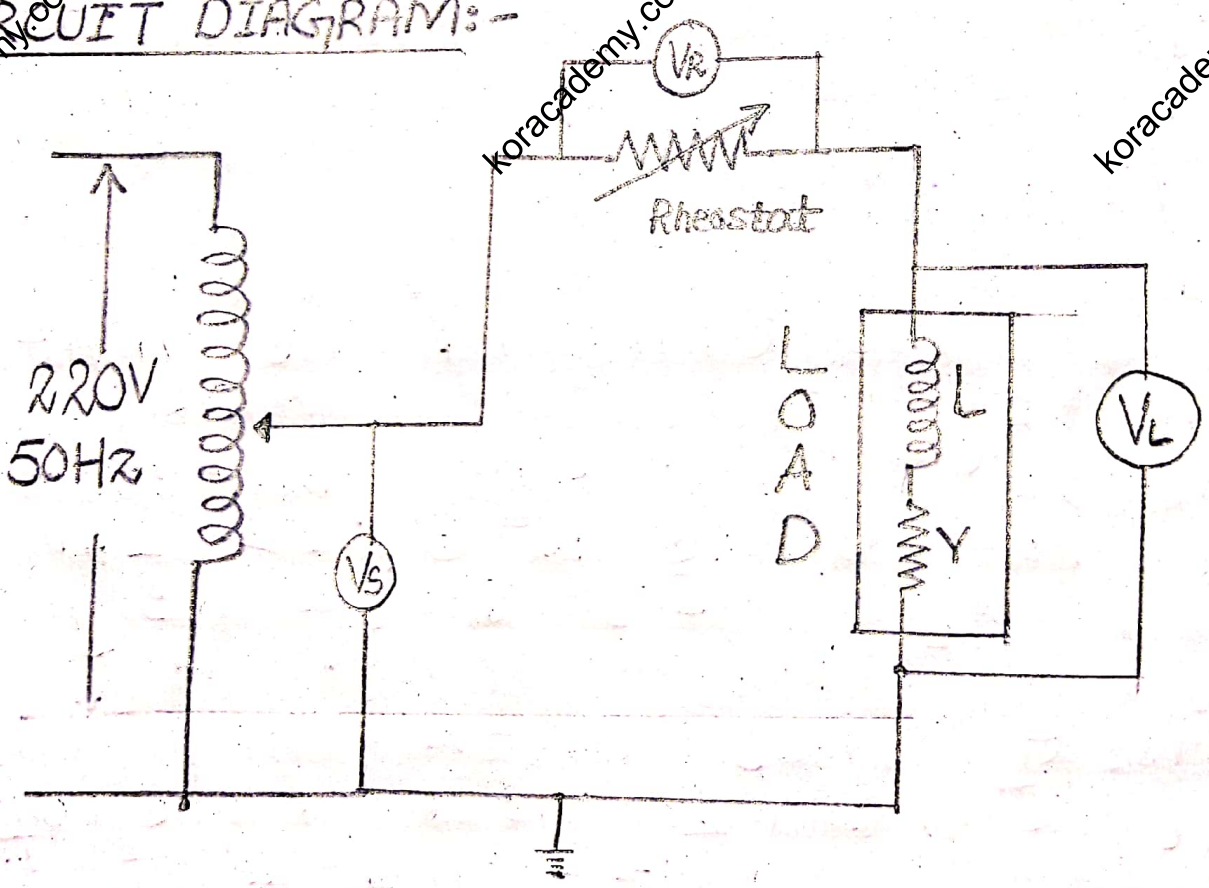
CONCLUSION:

I learn from this experiment that how we uses three voltmeter method to find power absorbed by the load.

PHASOR DIAGRAM:-



CIRCUIT DIAGRAM:-



OBSERVATION AND CALCULATION :-

S.No	V_S(V)	V_R(V)	V_L(V)	R	P
1	20.9	16.5	4.2	200 Ω	0.367
2	30	23.72	5.7		0.762
3	40	32.85	7.74		1.152
4	50.54	40.69	9.39		2.03

LAB NO 05:

To measure single phase power using three ammeters method.

APPARATUS:-

Auto-transformer (Power Supply)
Variable resistor
Inductive load
Ammeter.

THEORY:

Applying KCL at the node

$$I = I_1 + I_2$$

From phasor diagram

$$I^2 = (I_1 + I_2\cos\theta)^2 + (I_2\sin\theta)^2$$

$$I^2 = I_1^2 + I_2^2\cos^2\theta + 2I_1I_2\cos\theta + I_2^2\sin^2\theta$$

$$I^2 = I_1^2 + I_2^2 + 2I_1I_2\cos\theta$$

$$\boxed{\cos\theta = \frac{I^2 - I_1^2 - I_2^2}{2I_1I_2}}$$ Power factor.

$$P = IV\cos\theta$$

$$P = I_1 R I_2 \times \frac{I^2 - I_1^2 - I_2^2}{2 I_1 I_2}$$

$$\boxed{P = \frac{R}{2}\left(I^2 - I_1^2 - I_2^2\right)}$$

PROCEDURE:

The circuit is designed according to the shown circuit diagram.

Observe the values of currents I, I_1 and I_2 with the help of ammeters.

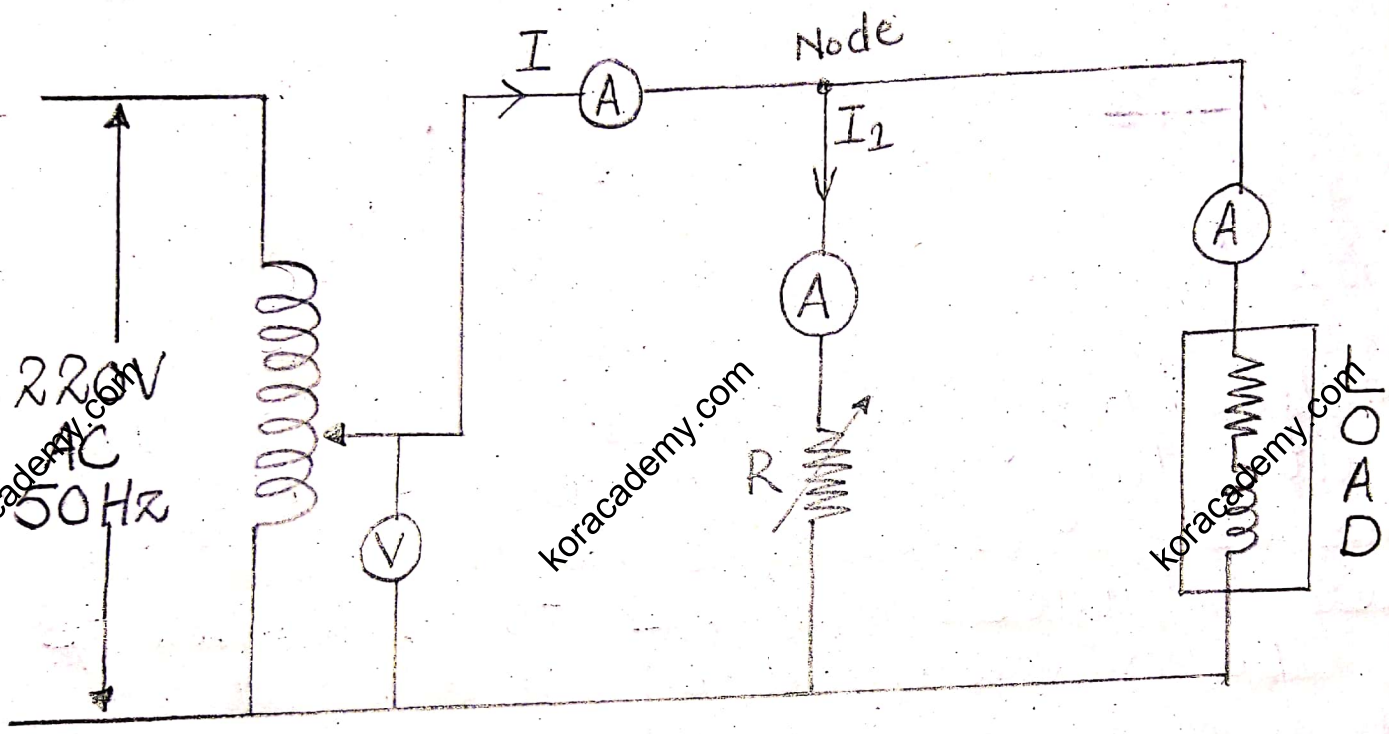
Put these values in the above formula to calculate the power.

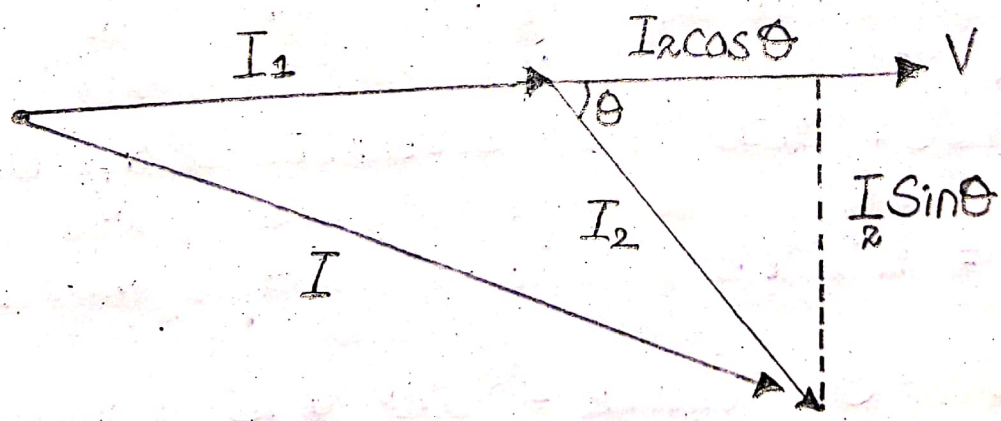
PRECAUTIONS:

The circuit must be properly designed.

Values of currents should be noted carefully

Calculations must be accurate.





OBSERVATION AND CALCULATIONS

S No	R	V	I (A)	I_R (A)	Cosθ	P
1	100Ω, 2A	30v	0.35	1.6	1.03	58W
2		40v	0.4	2	1.30	104W
3		50v	0.52	2.47	1.031	131.4W

LAB #06:-

To measure the power factor of a load using whattmeter, voltmeter and ammeter

APPARATUS:

Auto transformer
Ammeter
Wattmeter
Power supply
Inductive Load.

THEORY:

Auto transformer provide us with the desired voltage or current using a single coil. The wattmeter is use to measure the average power.

When it is calibrated for DC it works for AC as well. It is because it responds to the average value.

PROCEDURE:

Make the circuit according to the diagram.

Turn on the power supply & note down the readings.

W attmeter gives the average power across the load.

Voltmeter gives the source voltage and ameter gives current.

To calculate power factor, use formula

$$\cos\phi = \frac{P}{V_{rms} I_{rms}}$$

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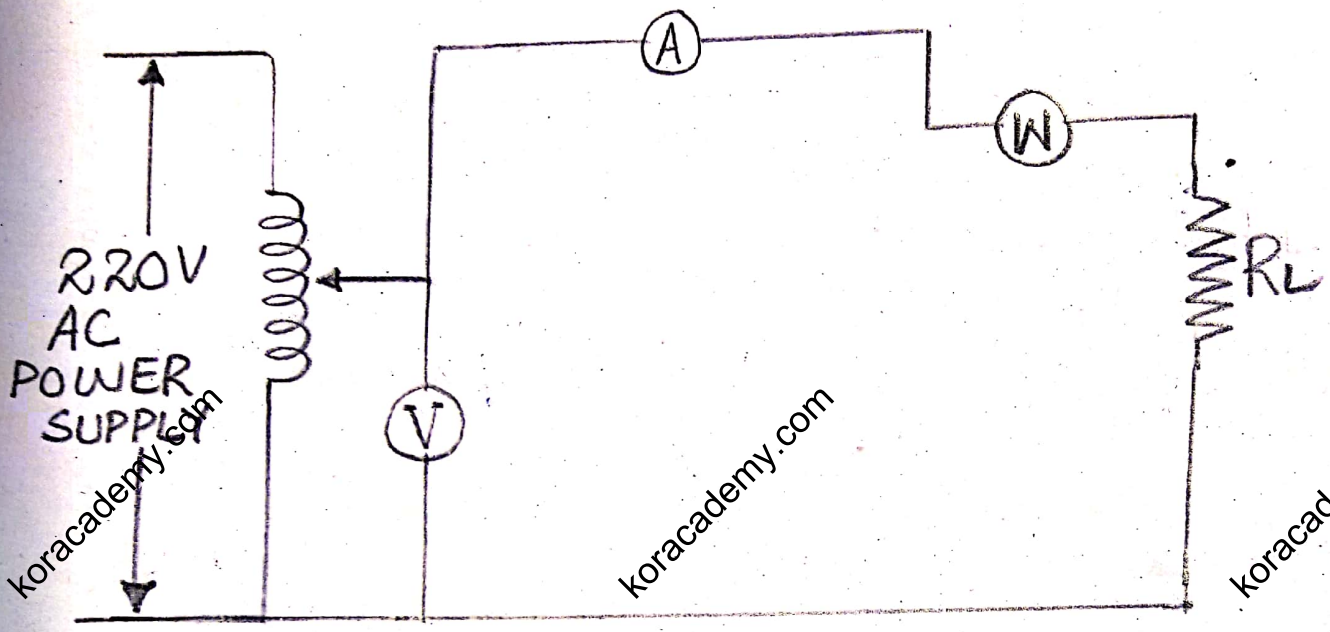
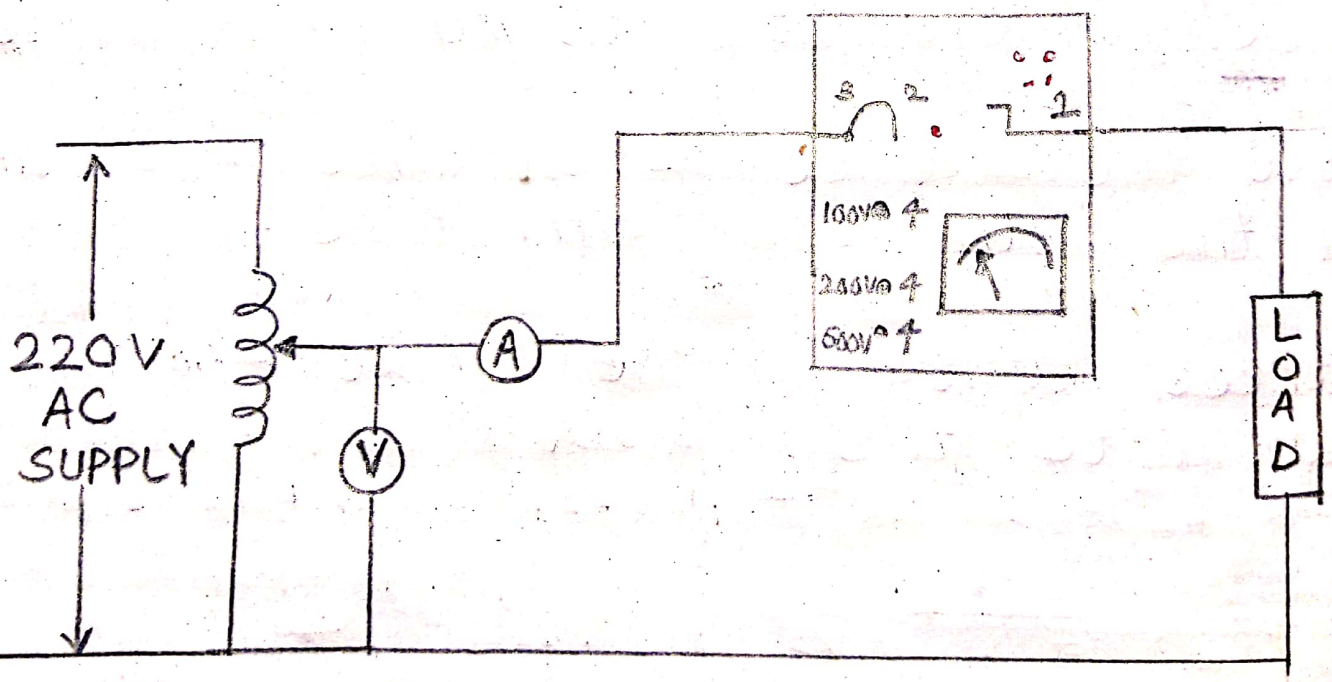
PRECAUTIONS:

Make the circuit properly

Make connections tightly

Take readings several times to avoid the Errors





$$P = \frac{1}{T}\int_0^T V_L \, dt$$

$$P.f = \frac{P}{S} = \frac{P}{VI}$$

$$P.f = \cos\phi = \frac{P}{VI}$$

S.No	V(V)	I(A)	P(W)	P.f	Avg Power factor
1	35	1.2	40	0.952	0.926
2	48	1.5	65	0.902	
3	55	1.8	95	0.959	

1) $P.f = \frac{P}{V_{rms} I_{rms}} = \frac{40}{(30)(1.2)} = 0.952$

2) $P.f = \frac{65}{48 \times 1.5} = 0.902$

3) $P.f = \frac{95}{55 \times 1.8} = 0.952.$

LAB # 07:

To measure current in a circuit using clamp meter.

THEORY:

Clamp meter is a device which is used for measurment of current. We will not break wire in case of clamp meter. In case of ammeter we have to break the wire. Clamp meter is mostly use for AC current measurment and can be use for DC current measurment Principle of working of both are different.

WORKING PRINCIPLE OF AC CLAMP METER:

It works on the principle of (Current transformer). It is use to step-down current.

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

$$I_2 < I_1$$

$$N_2 > N_1$$

$$I_1 = \frac{N_2}{N_1} I_2 \qquad \boxed{\because N_1 = 1}$$

$$\boxed{I_1 = N_2 I_2}$$

We know N_2 and ammeter gives the value of I_2. The multiplication of these two currents gives the desired current.

WORKING PRINCIPLE OF DC CLAMP METER:

We cannot use transformer in DC clamp meter because current flowing through the wire is constant. No change in the current flowing through primary coil. So no change in flux and when there is no change in flux so the Emf induce in the secondary coil is zero.

There is a sensor called **Hall Effect Sensor**. It is use to sence magnetic field.

Hall Effect Sensor Consist of a semi-conductor sheet. The arrangment is shown in figure.

From Amperes law we know that when current flow through the wire magnetic field is produce which is given by

$$B = \mu_0 n I$$

This magnetic field will cause Fm on the es. Due to which es will follow the path as shown in figure. The voltage shown by Voltmeter is proportional to magnetic field of wire (which is proportional to current flowing through the device.

PROCEDURE:

I made the circuit as shown in figure. I open the jaws of clamp-meter insext wire through which current is to measure and close the jaws. The reading of clamp-meter gives

current flowing through the wire.

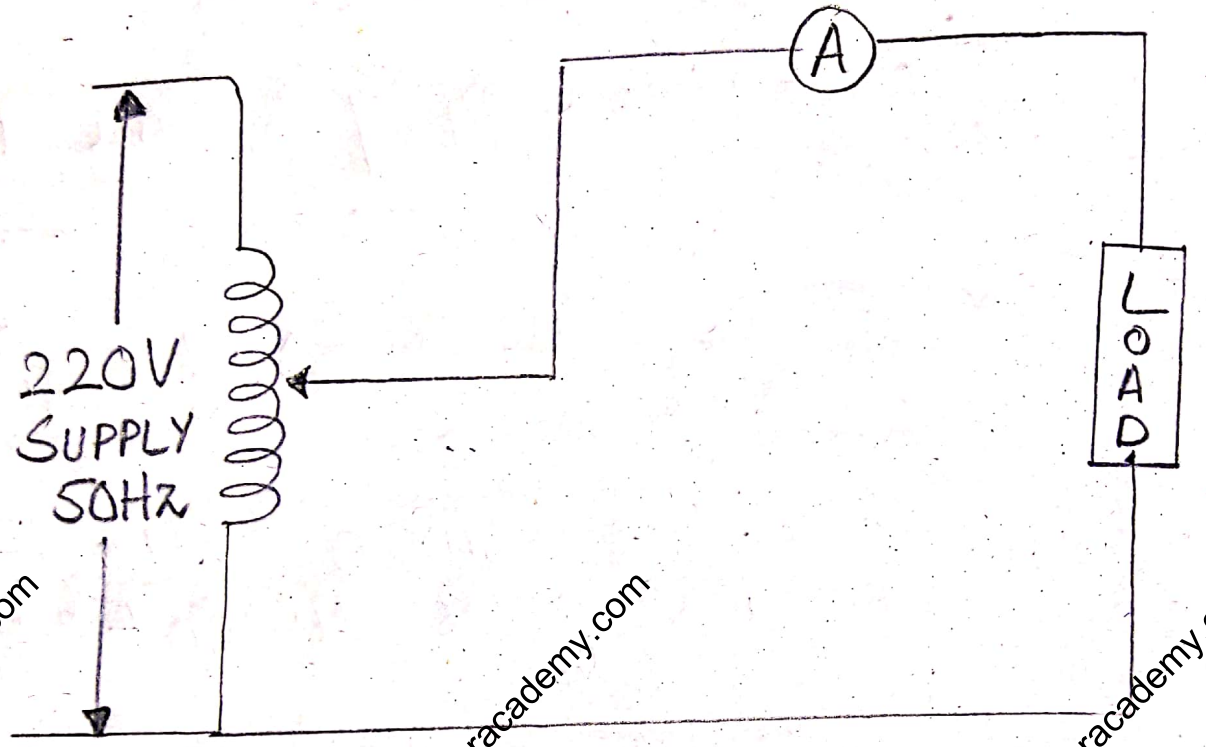
PRECAUTIONS:

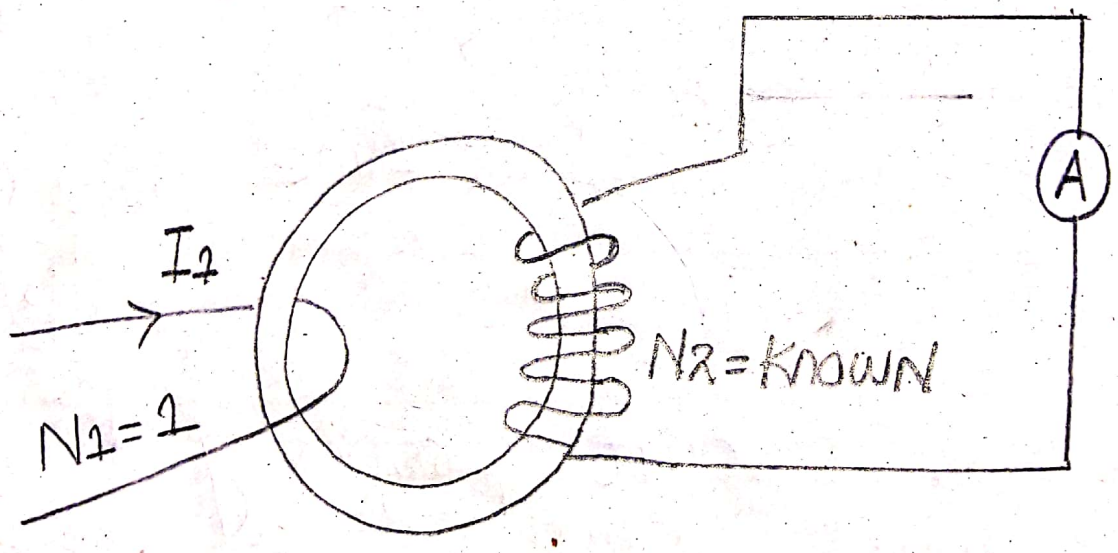
Insert a single wire.

If we insert both phase & neutral wire then clamp-meter will give zero.

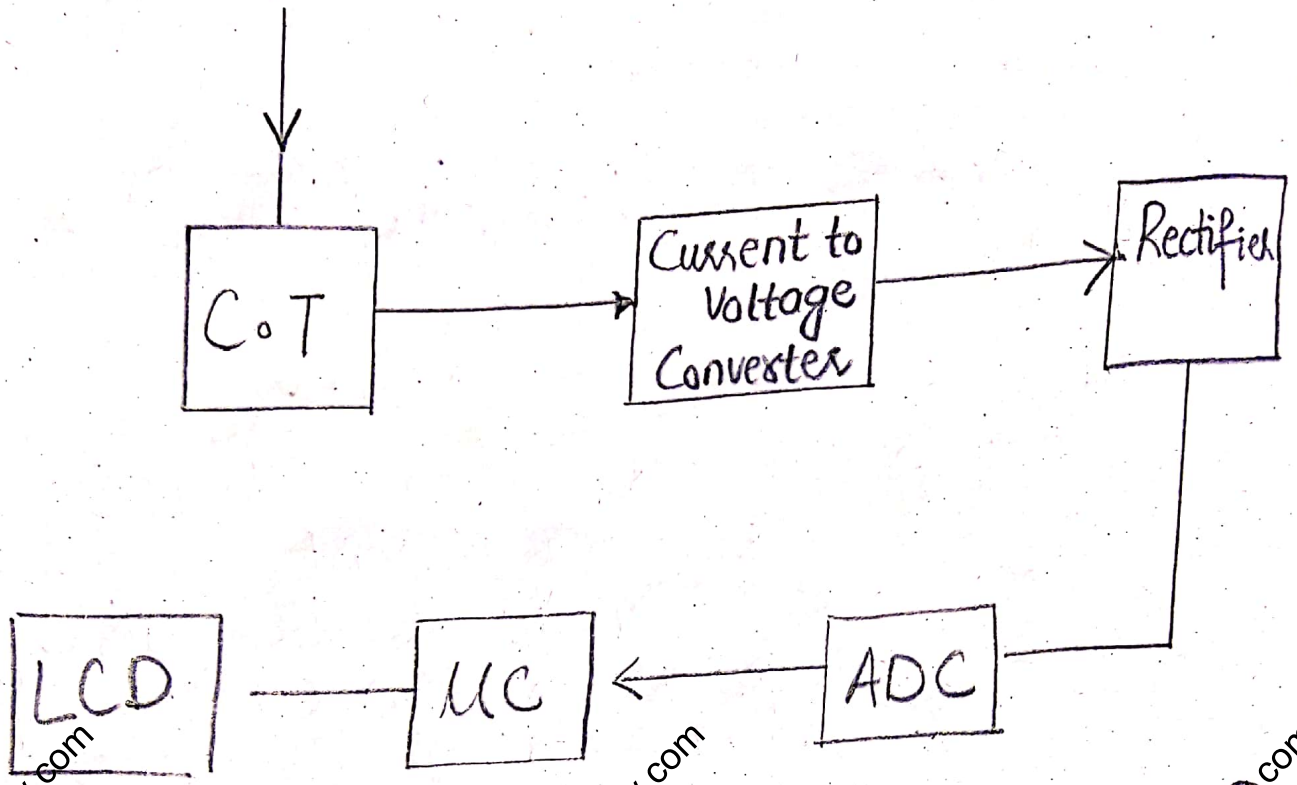
CONCLUSION:

We can measure current passing through the wire without breaking by the application of clamp-meter.

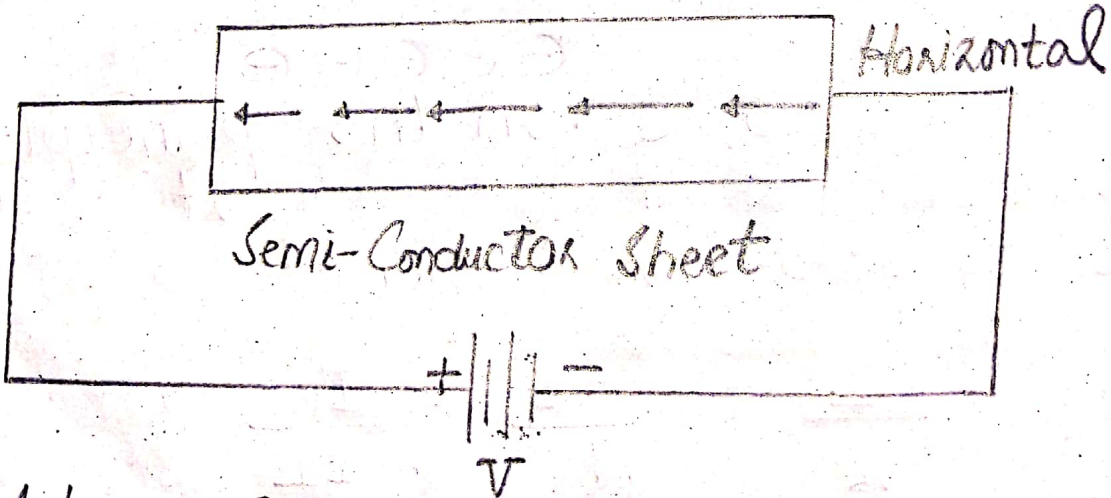




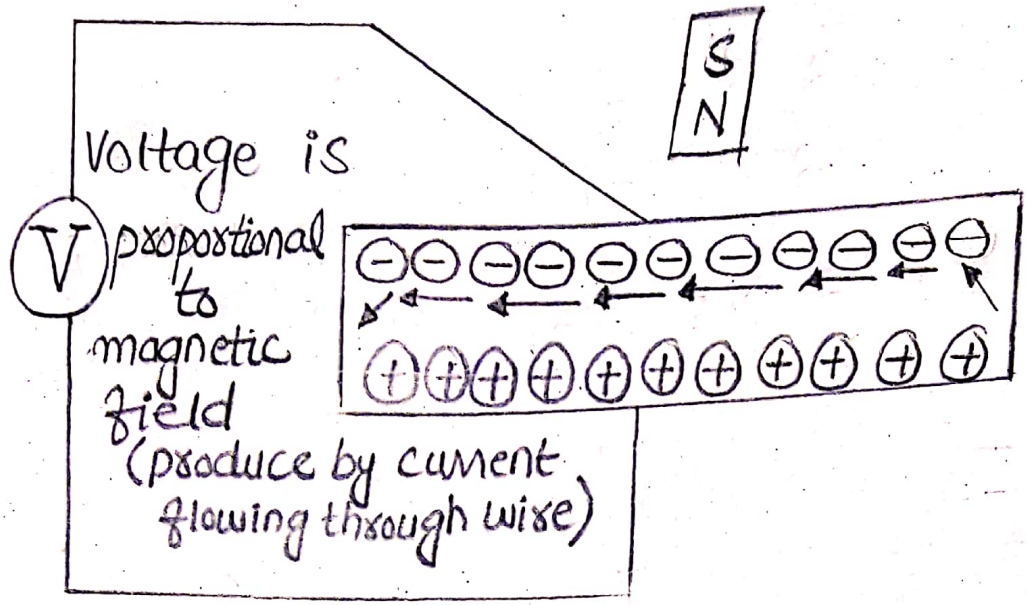
WORKING PRINCIPLE OF AC CLAMP METER



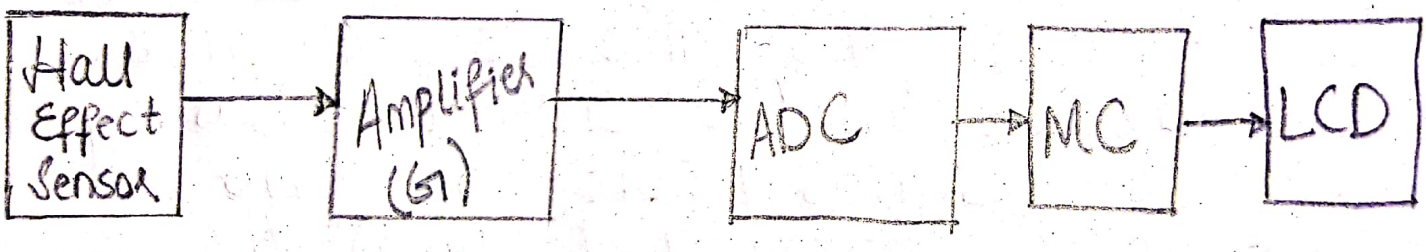
BLOCK DIAGRAM OF AC CLAMP METER



Hall Effect Sensor



WORKING PRINCIPLE OF DC CLAMP METER



BLOCK DIAGRAM OF DC CLAMP METER

LAB NO 08:

To measure the illuminance of light by lux meter.

APPARATUS:

Lux meter

THEORY:

We measure the brightness of light using lux meter.

WORKING PRINCIPLE OF LUX METER:

In lux meter we have a photo diode. Photo diode converts light energy to electrical energy Photo diode is always reverse biased. When the diode is reverse biased there is a minute current due to the minority carriers called Dark current. Dark current is the current in the absence of light.

When the diode is reverse biased so the depletion region is formed

Depletion region consist of no free charge carries. Depletion region consist of positive and negative ions. i-e ions of tri-valent and penta-valent impurity.

When tri-valent impurity gains electron it become negative ion and when penta-valent impurity losses electron it becomes positive ion.
In Depletion region there are electron in valence band but are not free. When light falls on the depletion region the electrons in the valence band absorbs the Energy ($E=hf$). The electrons which absorbs energy greater or equal to forbidden energy gap jumps to conduction band and are free, leaving a hole in the valence band. Now depletion region consist of electrons and holes due to which the current flows. The current is proportional to the no. of photon (brightness of light) striking the depletion region.

Important quantities related to light:-

1) Luminous flux:-

The amount of light radiated by a light source in 1sec Its unit is Lumen.

2) Luminous Intensity:-

It is define as

" Luminous flux per unit solid angle

$$1\,cd = 1\,lumen/st$$

3) Illuminance:-

It is define as

Illuminance flux per unit area. Unit is lux.

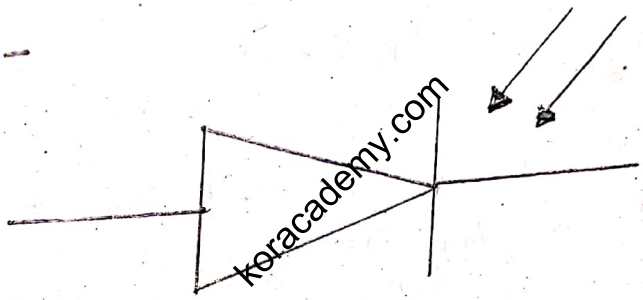
$$1\,lux = \frac{1\,lumen}{m^2}$$

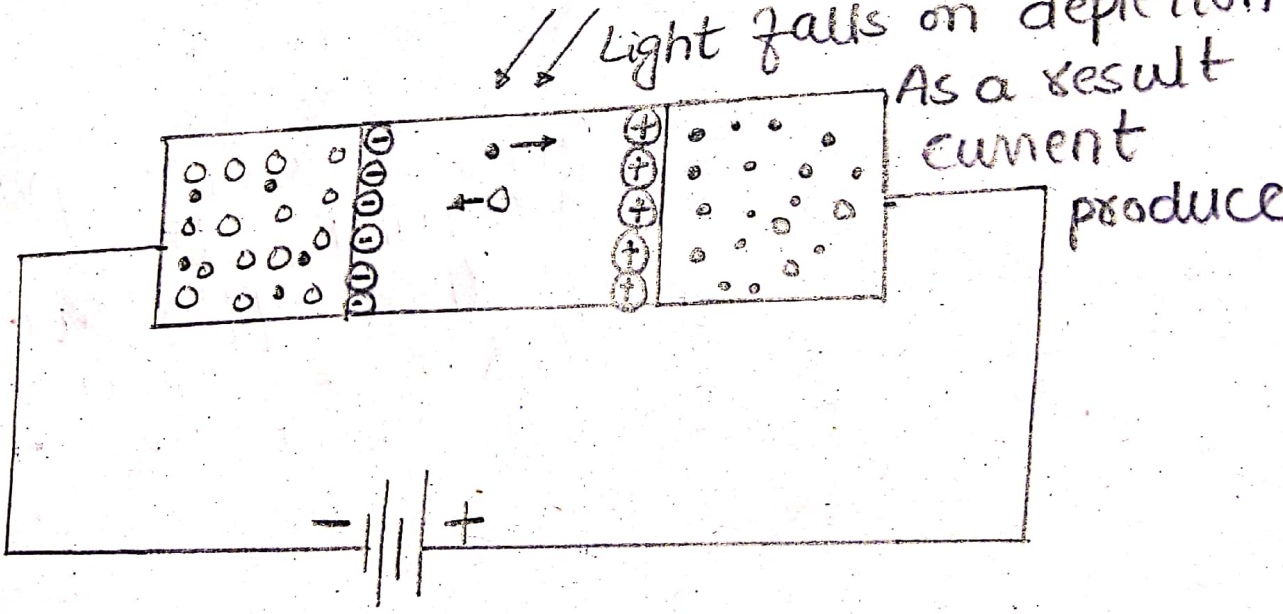
PROCEDURE:-

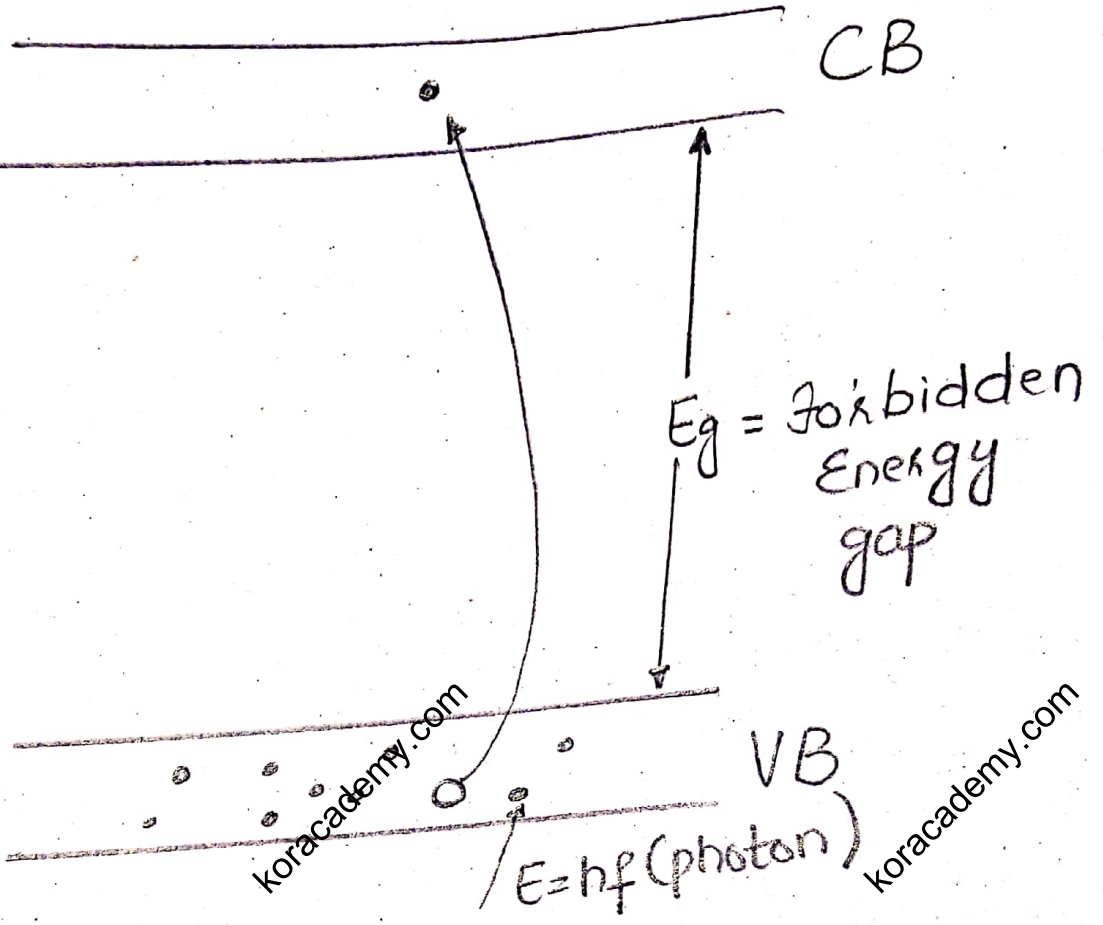
Hold Lux meter in front of light source. Meter will indicate illuminance of light

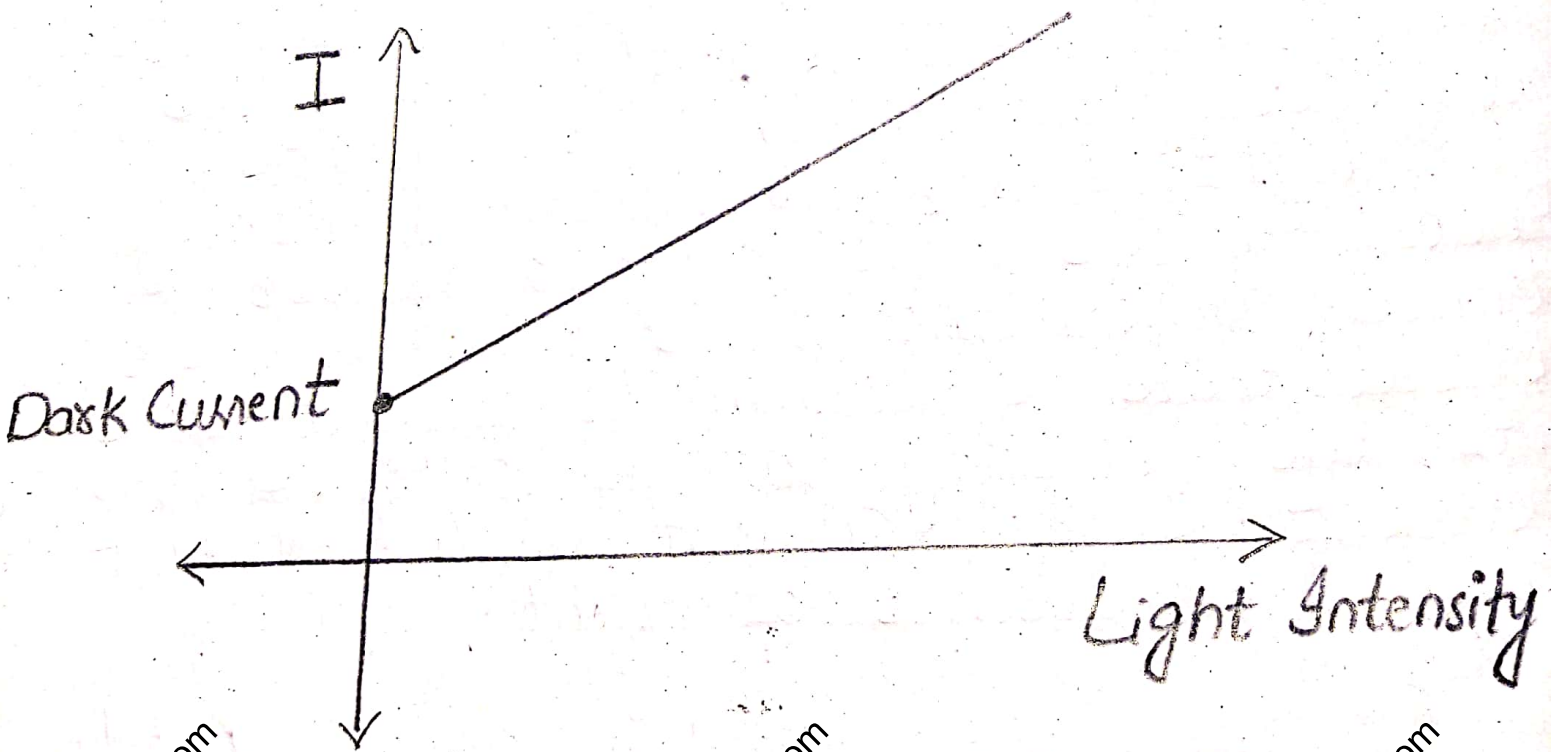
PHOTODIODE:-

SYMBOL:-

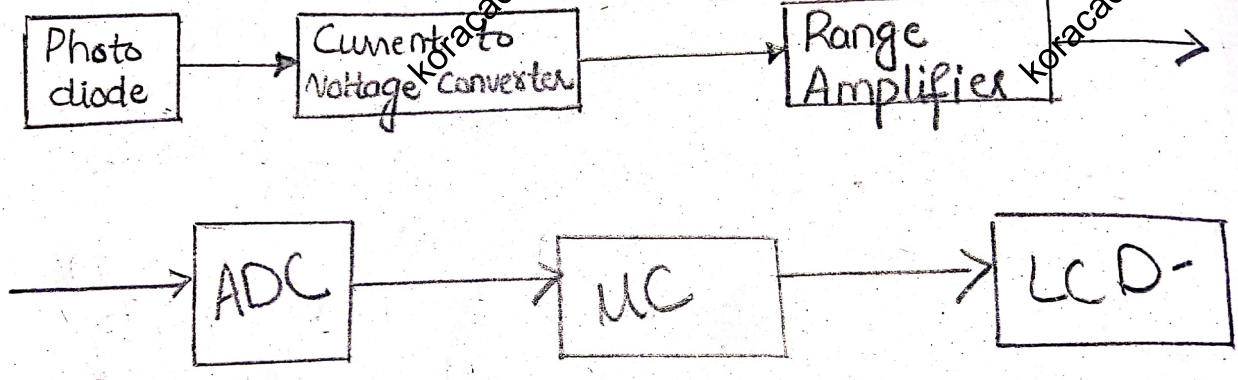








BLOCK DIAGRAM:-



LAB NO 10:

To measure the unknown resistance using wheat-stone bridge

APPARATUS:

Wheatstone bridge
Supply
connecting cables
ohm-meter

THEORY:

Wheatstone bridge is an amangment that is used to find the resistance of unknown resistor. It consist of a DC supply. It has four arms. Each consist of a resistor. Three resistors are of known resistances:

One resistor is of variable resistance and 4th resistance is unknown. The arms with known resistances are called ratio arms and the arm with variable resistance is called standard arm. Wheatstone bridge is use to find unknown resistance under balance condition.

under balance condition

$$R_2R_3 = R_1R_4$$

$$\Rightarrow \boxed{R_4 = \frac{R_2R_3}{R_1}}$$

PROCEDURE:

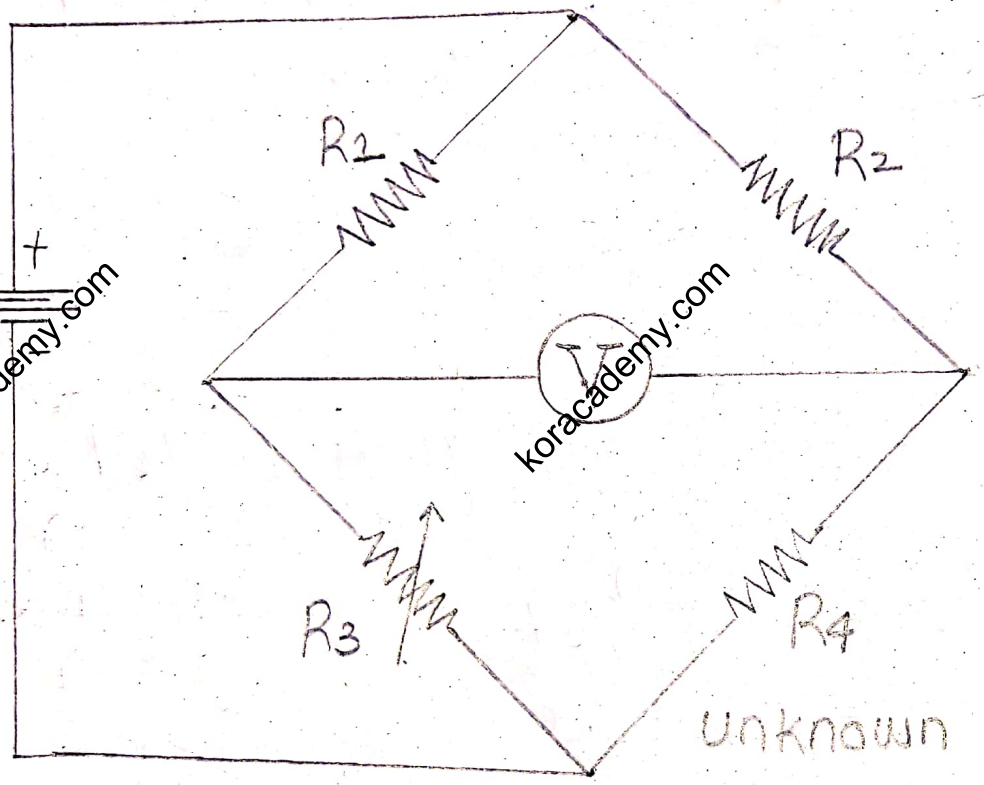
Supply DC voltage to the wheatstone bridge

Change the R3, variable resistor to make the bridge balance.

Using ohm-meter take the true value of unknown resistance R4.

Calculate the value of R4 using above formula

Calculate the Error.



WHEATSTONE BRIDGE

OBSERVATION AND CALCULATIONS:-

$R_1 = 2.2K\Omega$

$R_2 = 4.4K\Omega$

$R_3 = 152K\Omega$

True value of $R_4 = 307K\Omega$

Calculated $R_4 = \frac{R_2 R_3}{R_1}$

$= \frac{4400\ (152 \times 10^3)}{2200}$

$= 304K\Omega$

LAB NO 9:

To find the meter constant of a single phase analogue energy meter.

APPARATUS:

Analogue Energy meter
Load
Supply

THEORY:

Energy meter is a device that measures the amount of electrical energy consumed by any electrically powered device.

Construction Of an analogue energy meter:

It has a voltage coil which is highly inductive.

Aluminium disc supported by shaft. If disc rotates shaft also rotates. To support rotation, it consist of bearings.

To count rotations, it has registering system.

It has 4 main parts

1) Driving system

2) Moving system

3) Braking system

4) Registering system.

PROCEDURE:

Count the number of revolutions of the disc of energy meter.

Measure energy dissipated by load.

Put values in formula $K = \frac{N}{E}$

& find energy constant K.

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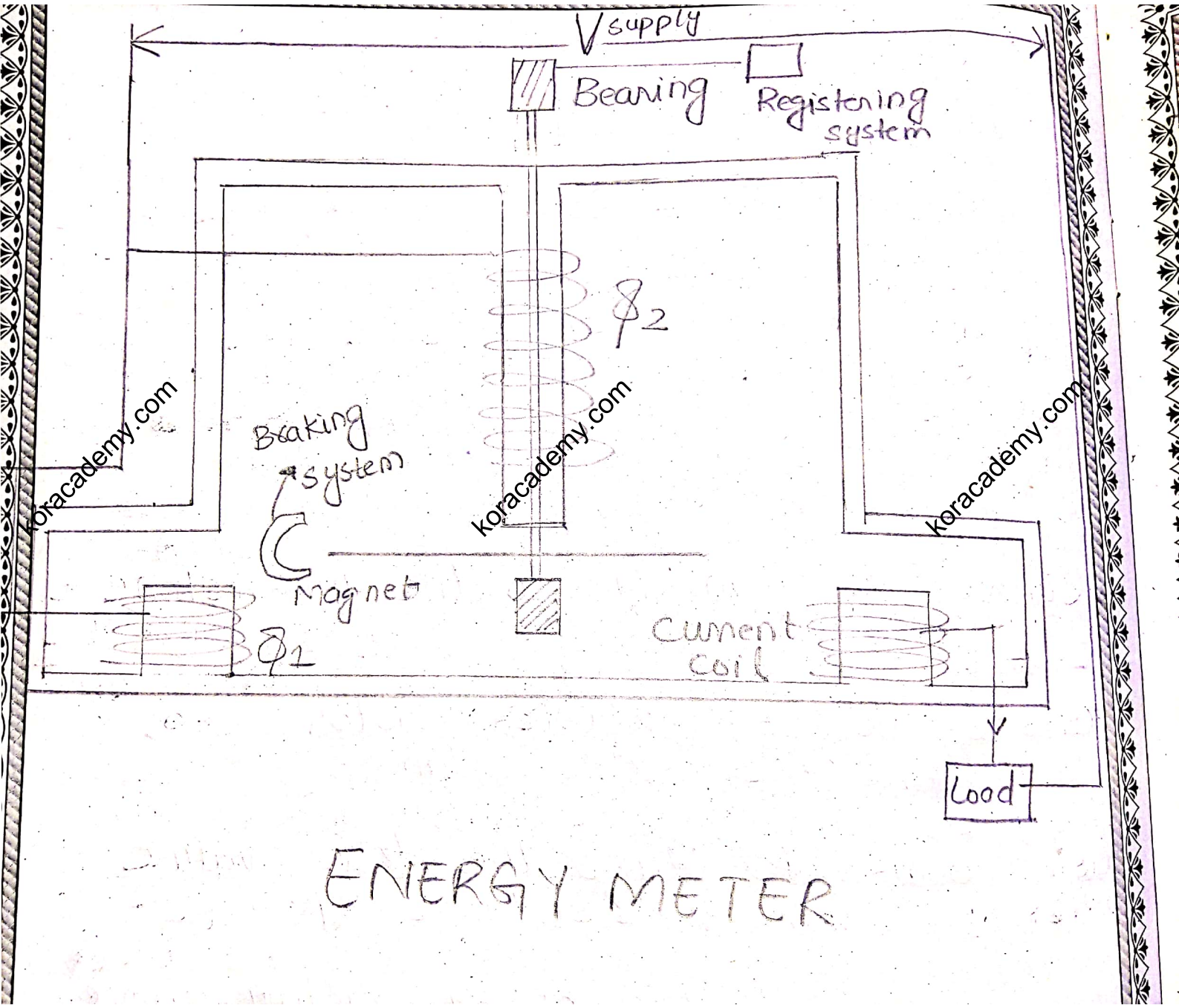


ENERGY METER

EXPERIMENT NO 11:

To measure the insulation resistance using digital insulation test

APPARATUS:

Digital insulation tester
Connecting wires
Electric heater.
Electric kettle.

THEORY:

INSULATION TESTER:

It is also called Megger. It is an instrument which is used to measure the insulation resistance of the electric machinery system.

It has an internal battery of 9V. Six cells of each 1.5V

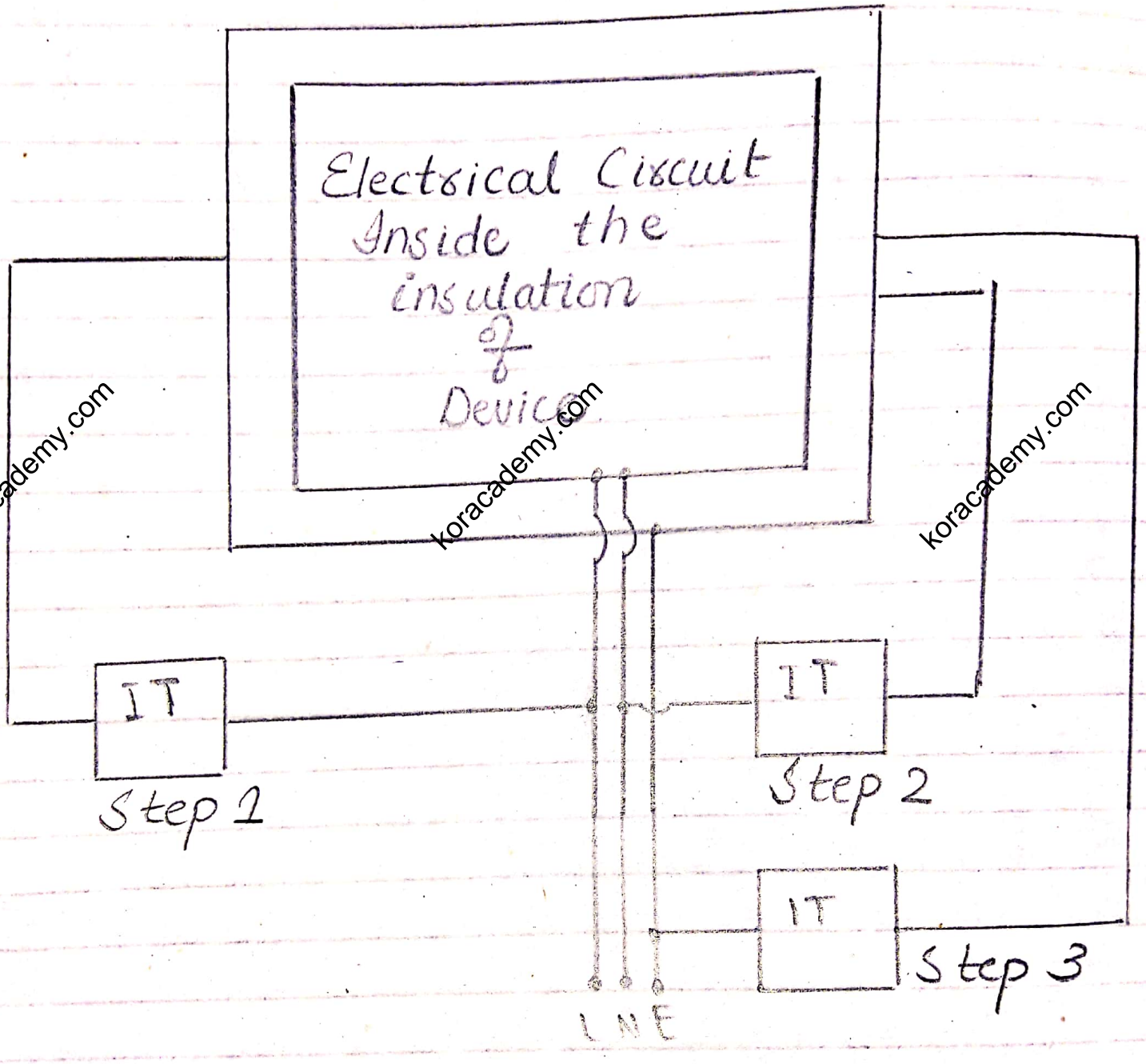
are connect in sexies. It has internal boost converter which step up the 9V DC to the sequired level.

PROCEDURE:

To test an electrical equiptment that either it is properly insulated or not following three steps.

Connect the one load of insulation meter to the insulation of equiptment and either load to the phase wire. If meter show very high value then equiptment is properly insulated otherwise not.

Connect one lead of the tester to the insulation of electrical instrument and other lead to the earth wire



TESTING AN ELECTRICAL DEVICE AND ITS INSULATION

EXPERIMENT # 12:

To learn the construction and working of DSO

THEORY:

OSCILLOSCOPE:

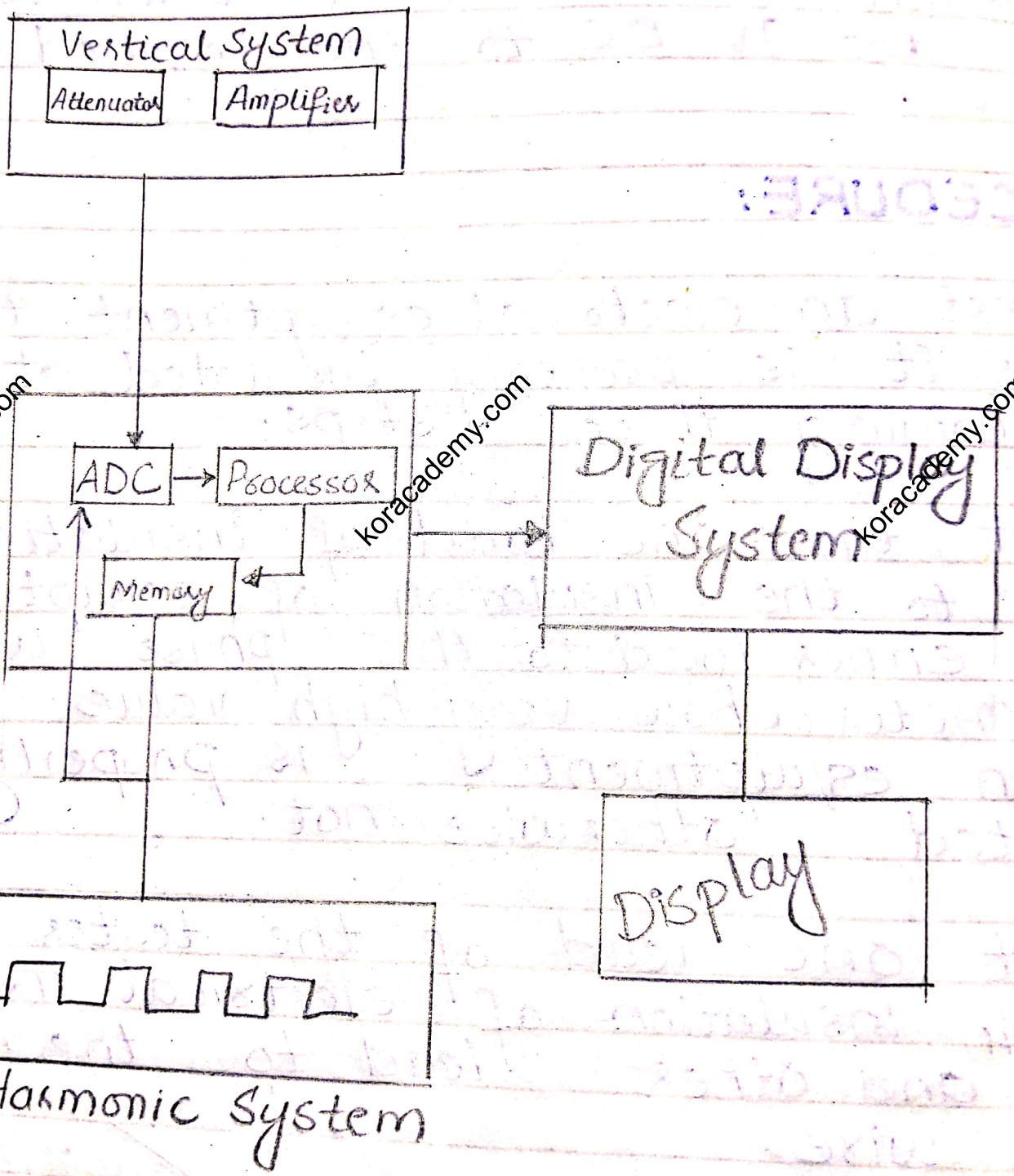
It is a device through which we can study the waveform of different signal or we can trace the electrical signals on oscilloscope we study 2D curve.

TYPES:

Normally we use two type of oscilloscope

CRO:

Cathode ray oscilloscope is use for analogue measuring instrument which contained on the cathode ray tube.



DSO:

Digital Storage Oscilloscope is a digital type device and which trace electrical signal and stoxe the curve and also measure different parameters automatic.

CONSTRUCTION:

It contained the following systems

VERTICAL SYSTEM:

This system has two cixcuitary

i) ATTENVATION:

If the input is very high so this cixcuit xeduce the input signal in lower amplitude It has low gain

ii) AMPLIFIER:

If electrical signal is so small so amplifies is responsible to increase the amplitude of input signal because it has gain greater than 1.

2) ACCUMULATION SYSTEM:

This system depends on the following components.

ADC:

Is a component which convert the analogue data to digital data by the following component.

1) SAMPLING (SAMPLER):

Sampling is the conversion of analogue signal to discrete values. Each sample is equal to distance from another samples.

Sampler is a circuit which contained

on a switch which is on for a time and off for specific interval of time.

2) QUANTIZER:

The peak to peak value is divided to equal distance which is known as level. No. of levels depends on ADC.

3) ENCODER:

Each level has its own binary codes. The code is comesponding to the digital value

1) Memory 2) Processor

c) HARMONIC SYSTEM:

Harmonic system has a clock ckt. It provide the clock pulse for the ckt elements But every signal ckt

required the triggering signals.

d) TRIGGER SYSTEM:

Circuit element is not working until triggering signal is not provided.

e) DIGITAL SYSTEM:

Digital system display the wave on display of oscilloscope.

PROCEDURE:

Take a probe and connect with channel and probe is connected with ground.

If the wave is square so there is no error. But if there is error so make the corection in the error by changing capacitance value of probe.

Apply the input signal to the probe and observe different parameters.

PRECAUTION:

Find the error in probe.

The channel must be specified.

The error should be minimize by adjusting the capacitance.