A LAB MANUAL

on

MASUREMENTS & SENSOR'S (20A02503P)

Prepared by

Mr.T.SAI SREENIVAS PRASAD

Asst. Professor

Department of EEE

SREE RAMA ENGINEERING COLLEGE

Approved by AICTE, New Delhi – Affiliated to JNTUA, Ananthapuramu
Accredited by NAAC with 'A' Grade
An ISO 9001:2015 & ISO 14001:2015 certified Institution
Rami Reddy Nagar, Karakambadi road,Tirupati-517507

Department of Electrical and Electronics Engineering

MEASUREMENTS AND SENSORS LAB (20A02503P)

III B.Tech I Semester (R20) EEE

List of Experiments

1. Calibration and Testing of single phase energy Meter
2. Calibration of dynamometer power factor meter
3. Kelvin's double Bridge – Measurement of low resistance – Determination of Tolerance
4. Determination of Capacitance using Schering Bridge
5. Measurement of 3-phase reactive power with single-phase wattmeter
6. Measurement of parameters of a choke coil using 3-voltmeter and 3-ammeter methods
7. Calibration of LPF wattmeter – by Phantom loading
8. LVDT and capacitance pickup – characteristics and Calibration
9. Resistance strain gauge – strain measurement and Calibration
10. Determination of Inductance using Anderson bridge

Additional Experiments:

1. Determination of Coefficient of coupling between two mutually coupled coils
2. Wheatstone bridge – measurement of medium resistances

EXPERIMENT NO: **01** DATE:

CALIBRATION OF SINGLE -PHASE ENERGY METER

AIM: To determine the error and percentage error at 5%, 25% and 100% of full load current for the given single phase energy meter.

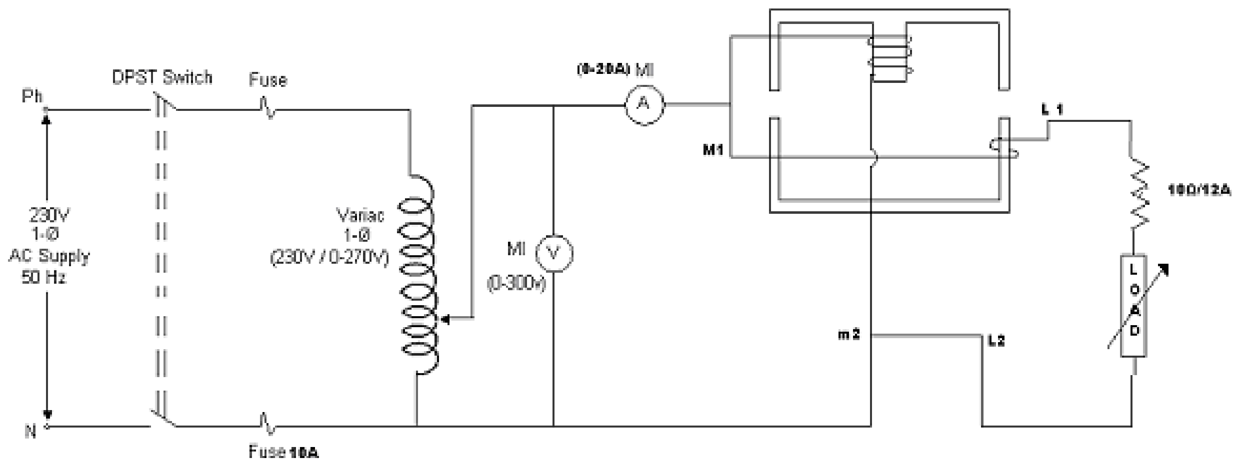
NAME PLATE DETAILS:

Meter constant	**:** 1200 rev/KWH
Rated Current	**:** 10A
Rated Voltage	**:** 240V
Rated frequency	**:** 50Hz

APPARATUS:

1. Voltmeter **:**(0-300V) MI
2. Ammeter **:** (0-20A) MI
3. 1-Φ variac **:**(230V / 0-270V)
4. Rheostats **:**350Ω / 1.2A, 29Ω / 4.1A, 10Ω / 1.2A
5. Stop watch
6. Connecting wires

CIRCUIT DIAGRAM:



THEORY:

Energy meter mainly consists of 4 parts of the operating mechanism. They are

1. Driving system
2. Moving system
3. Breaking system
4. Registering mechanism

The driving mechanism of the meter consists of two electromagnets. The core of these electromagnets is made up of steel laminations. The coil of one of the electromagnets is excited by the load current. This coil is called the current coil. The coil of second electromagnet is connected across the supply voltage and therefore carries a current proportional to the supply voltage. This coil is called the pressure coil. Consequently, the two electromagnets are known as series and shunt magnets respectively. Copper shading bands are provided on the central limb.

The function of these bands is to bring the flux produced by the shunt magnet exactly in quadrature with the applied voltage.

Moving system:

This consists of an aluminum disk mounted on a light alloy shaft. This disc is positioned in the air gap between series and shunt magnets. The 'Al' disc moves in the field of this magnet and thus provides a breaking torque.

Braking System:

A permanent magnet positioned near the edge of the aluminum disc forms the braking system. The aluminum disc moves in the field of the magnet and thus provides a braking torque. The position of the permanent magnet is adjustable and therefore braking can be adjusted by shifting the permanent magnet to different radial positions.

Registering Mechanism:

The function of a registering or counting mechanism is to record continuously a number which is proportion to the revolutions made by the moving system.

PROCEDURE:

1. Connect the circuit as shown in figure.
2. Connect the load rheostat 10 Ω/12A in series with load.
3. Keep the variac in minimum output voltage position.
4. Keep the load in maximum position.
5. Adjust the variac output equal to the rated voltage of energy meter.
6. Adjust the load till rated current of energy meter passes through it. Note down the voltmeter and ammeter readings.
7. Note down the time taken for 2 revolutions of disc in the energy meter.
8. Switch off the supply.
9. Repeat the above steps for different currents.

TABULAR COLUMN:

S.No	Voltage	Current	Time taken for revolutions (S)	No. of revolutions	Actual Energy W_a (W)	Energy registered by energy meter W_R (W)	Error $W_R - W_a$ (W)	%Error

THEORITICAL CALCULATIONS:

Actual energy consumed during ‘n’ revolutions

W_a = V*I*t / 3600 watt-hour

where V= Voltage (V)

I= Current (A)

t = Time (S)

Energy registered by energy meter

W_R = n / meter constant

Error = $W_R - W_a$

% Error = $[(W_R - W_a) / W_a] * 100$

RESULT:

EXPERIMENT NO: **02** DATE:

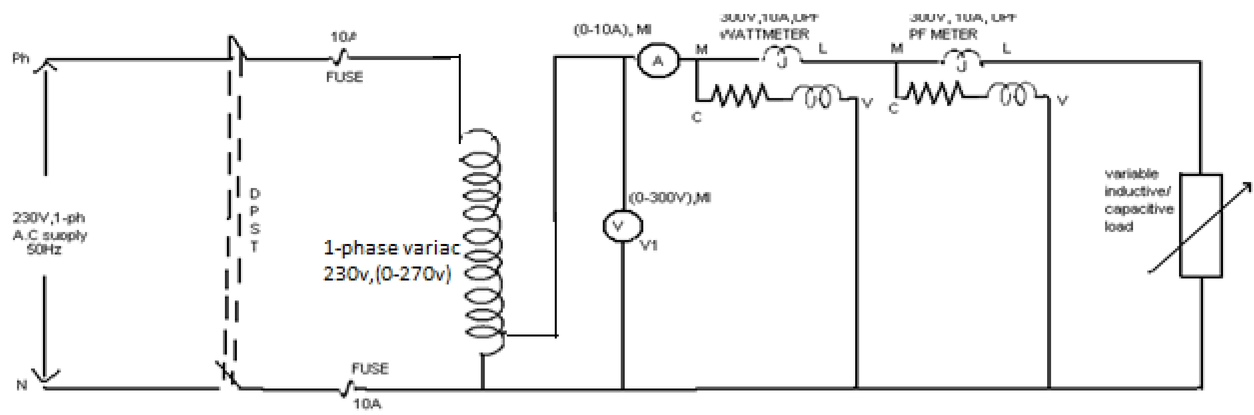
CALIBRATION OF SINGLE-PHASE POWER FACTOR METER

AIM: To calibrate single phase power factor meter with inductive and capacitive loads.

APPARATUS:

1. Ammeter (0-10A) MI
2. Voltmeter (0-300V) MI
3. Wattmeter (300V, 10A, UPF)
4. 1-Φ variac 230V / 0-270V
5. 1- Φ power factor meter (300V, 10A)
6. Variable inductive / capacitive loads
7. Connecting wires

CIRCUIT DIAGRAM:



THEORY:

Power factor meters like wattmeter have a current circuit and a pressure circuit. The current circuit carries the current (or definite fraction of this current) in the circuit whose power factor is to be measured. The pressure circuit is connected across the circuit whose power factor is to be measured and is usually split up into two parallel paths- one inductive and the other non-inductive. The deflection of the instrument depends upon the phase difference between the main currents in the two paths of the pressure circuit i.e. upon the phase angle or power factor of the circuit. The deflection is indicated by a pointer.

The moving system of power factor meters is perfectly balanced at equilibrium by two opposing forces and therefore there is no need for a controlling force. There are two types of power factor meters.

a) Electro-dynamometer type and

b) Moving Iron type

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Keep the variac in the minimum output voltage position.
3. The inductance / capacitance is kept in maximum position.
4. Vary the variac till the rated voltage 230V is obtained in voltmeter.
5. The inductive load is also varied to get power factor between 0.5 lag and near unity.
6. At every power factor setting, note down the voltmeter, ammeter and watt meter readings in addition to power factor reading.
7. The above procedure for capacitance load is repeated so that power factor varies between 0.5 lead and near unity.
8. Calculate the error by using appropriate formula.

FORMULAE:

Power factor $\cos\Phi_t$ = Active Power (KW) / Apparent Power (KW)

= Wattmeter reading / (VI)

Error = PF meter reading – true PF = $\cos\Phi_m - \cos\Phi_t$

%Error = $[(\cos\Phi_m - \cos\Phi_t) / \cos\Phi_t] * 100$

TABULAR COLUMNS:

INDUCTIVE LOAD

S. No	Supply Voltage (V)	Ammeter reading (A)	Wattmeter reading (W)	True PF $\cos\Phi_t$= W/(VI)	Measured PF $\cos\Phi_m$	Error $\cos\Phi_m$-$\cos\Phi_t$	% Error

CAPACITIVE LOAD

S. No	Supply Voltage (V)	Ammeter reading (A)	Wattmeter reading (W)	True PF $\cos\Phi_t$= W/(VI)	Measured PF $\cos\Phi_m$	Error $\cos\Phi_m$-$\cos\Phi_t$	% Error

RESULT:

EXPERIMENT NO: **03** DATE:

CROMPTON TYPE DC POTENTIOMETER

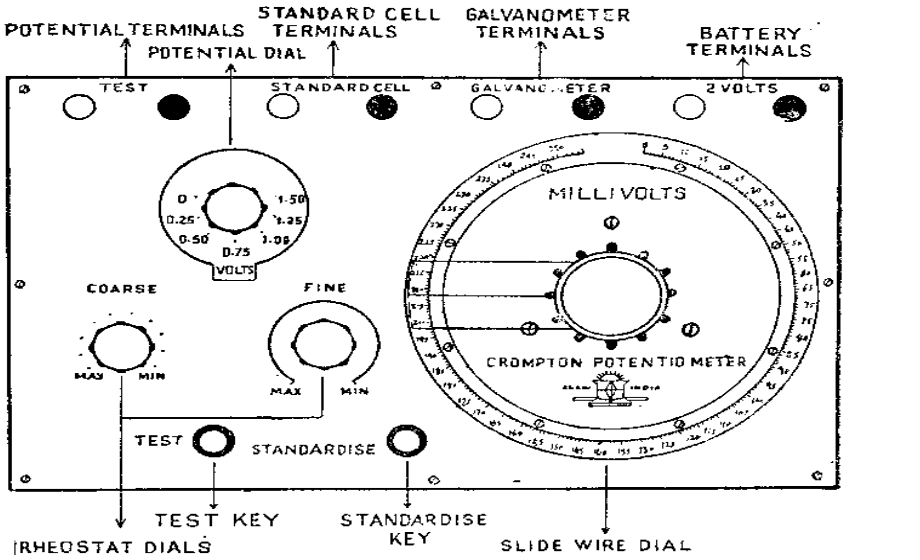
(a) Calibration of PMMC ammeter
(b) Calibration of PMMC voltmeter

AIM: To calibrate PMMC ammeter & PMMC Voltmeter using Crompton type DC Potentiometer.

APPARATUS:

DC Potentiometer
PMMC Ammeter
PMMC Voltmeter
Volt Ratio Box
Standard cell
Battery

CIRCUIT DIAGRAM:



STANDARDISING THE POTENTIOMETER

PROCEDURE:

1. Connect the Galvanometer, standard Cell and Battery to their appropriate terminals on the Standard Cell and Battery.
2. Set the potential dials to the exact voltage of the standard cell.
3. Press the STANDARDISE key and obtain a balance on the galvanometer by rotating the battery rheostats (Coarse and Fine).
4. Galvanometer should no deflection with STANDARDISE key pressed. Then the potentiometer has been standardized for use.

CALIBRATION OF PMMC VOLTMETER

1. Connect the RPS, voltmeter to the primary of the Volt Ratio Box, with proper polarity.
2. Connect the secondary terminals (marked 1.5V) to the 'TEST' terminals of the potentiometer. Other connections need not be disturbed.
3. Adjust the RPS to a position such that voltmeter reads say 4V.
4. Press the TEST key and obtain the balance on the galvanometer by changing the setting of the potential dials.
5. Note the readings of the potential dials.

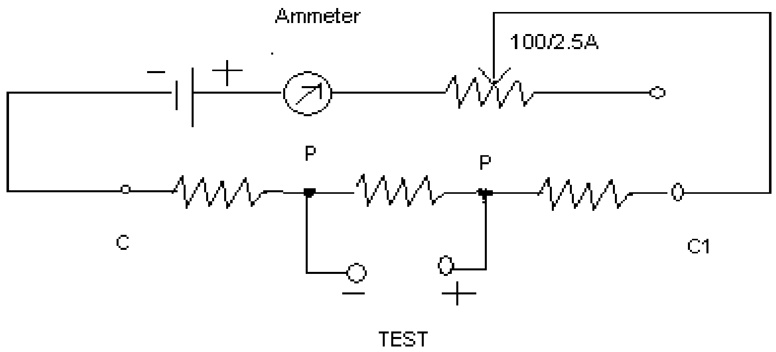
   Ex. Input terminals used for volt ratio box E & 150V
   Potentiometer reading = 0.042V
   Input voltage = (150/1.5)0.042 = 4.2v

TABULAR COLUMN:

S.NO	Measured value	Actual value=measured value/actual value	Error	%error

CALIBRATION OF PMMC AMMETER

CIRCUIT DIAGRAM:



PROCEDURE:
1. Connect the circuit as per the circuit diagram.
2. Make other connections as usual.
3. Vary the RPS such that ammeter shows some readings say (7.5A).
4. Standardize the potentiometer and measure the unknown potential across the shunt potential terminals as usual.
5. The value of current flowing is then found by dividing the measured potential in volts by the resistance of shunt in ohms.

   Ex. By using potentiometer shunt of 0.1Ω
   Potentiometer reading = 0.7545V
   Current flowing = 0.7545/0.1 = 7.545A
   %Error = 6.66

RESULT:

EXPERIMENT NO: **04** DATE:

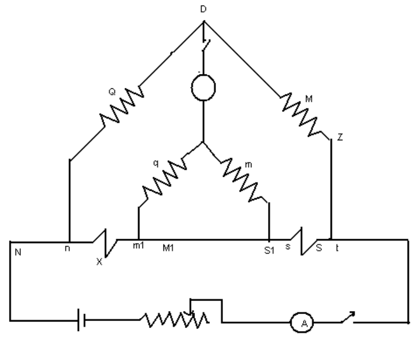
KELVIN'S DOUBLE BRIDGE

AIM: To determine the unknown resistance of a resistor (low resistance) using Kelvin Double Bridge.

APPARATUS:

1. Kelvin's Double Bridge
2. Sensitive Galvanometer
3. Battery (or) DC source
4. Four terminal resistors, Two terminal resistor, cable

CIRCUIT DIAGRAM:



THEORY:

The Kelvin's double bridge incorporates the idea of a second set of ratio arms- hence the name double bridge-and the use of four terminal resistors for the low resistance arms. The first set of ratio arms is M, Q. the second set of ratio arms m,q is used to connect the galvanometer to a point 'd' at the appropriate potential between the known resistance X and the standard resistance S.

The ratio q/m is made equal to M/Q.Unde4r balance conditions there is no current through the galvanometer, which means that the voltage drop between n and D is equal to the voltage drop between n,t.

PROCEDURE:

1. Give supply to the terminals marked by 'Battery' from the D.C source (or) battery.
2. Connect the galvanometer to the terminal marked "Galvanometer".
3. Connect the unknown resistor to the standard arm.
4. Press the galvanometer key marked 'INITIAL' and notes the deflection. If the deflection is high adjust the variable arm. If the deflection is small, release 'INITIAL' key and press FINAL key adjust slide wise dial until the deflection is zero.

5. The unknown resistance can be calculated using the formula,

X = (milliohm decade value + slide wire milliohm value) * Range Multiplier

RESULT:

EXPERIMENT NO: **05** DATE:

DETERMINATION OF CAPACITANCE USING SCHERING BRIDGE

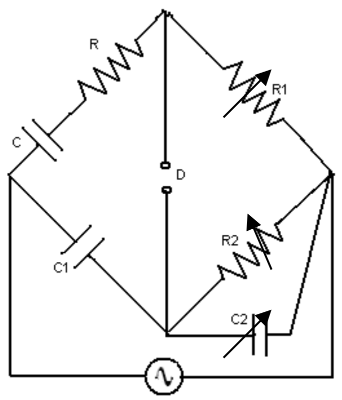
AIM:

To determine the capacitance of a capacitor and its dissipation factor.

APPARATUS:

S.no	Name of the equipment
1.	Schering Bridge
2.	Probes
3.	galvanometer

CIRCUIT DIAGRAM:



THEORY:

This bridge is a mod˙ ˜C ion of the Maxwell's Inductance-Capacitance Bridge. In this method the self-inductance is measured in terms of a standard capacitor. This method is applicable for a precise measurement of self-inductance over a wide range of values. Fig shows the connection of the bridge for balanced condition.

L = Self-inductance to be measured

r = Resistance connected in series with the self inductor.

R,P = Known non-inductive resistances

C = fixed standard capacitor.
E

At balanced condition **L = CR (Q+2r)**

PROCEDURE:

(a)SCHERING BRIDGE:

1. Make the connections as shown in the figure, using AC supply of 1KHZ and head phones.
2. Connect one unknown capacitor.
3. Set the capacitor dial C_2 and resistance dial R at zero positions.
4. Adjust R_1 to some value.
5. Vary R_2 to minimize the sound in the head phone.
6. Note the values of R_1, R_2 & C_1.
7. Calculate the value of unknown capacitor using the formula.

$$C = C_1R_2/R_1$$

EXAMPLE: C1 =0.01μF

R1=2100 OHMS

R2=2100OHMS

$C = C_1R_2/R_1$

=0.01μF

<u>To find the dissipation factor of a capacitor:</u>

1. Without disturbing the setting of the bridge inductance some resistance 'R' say 500Ω.
2. Now adjust the capacitor C_2 to minimize the sound in the head phone.
3. Calculate the dissipation factor using the formula

Dissipation factor D = ωCR

Where ω = 2Πf

f = frequency of the oscillator

R = series resistance of a capacitor representing the loss in the capacitor

C = Capacitance of the capacitor

4. Repeat the experiment with different values of resistance 'R'.

EXAMPLE:

Dissipation factor D = ω*C*R

=2Π*E+3*0.01*E-6*R

=2Π*E+3*0.01*E-6*600

=0.077

RESULT:

EXPERIMENT NO: **06** DATE:

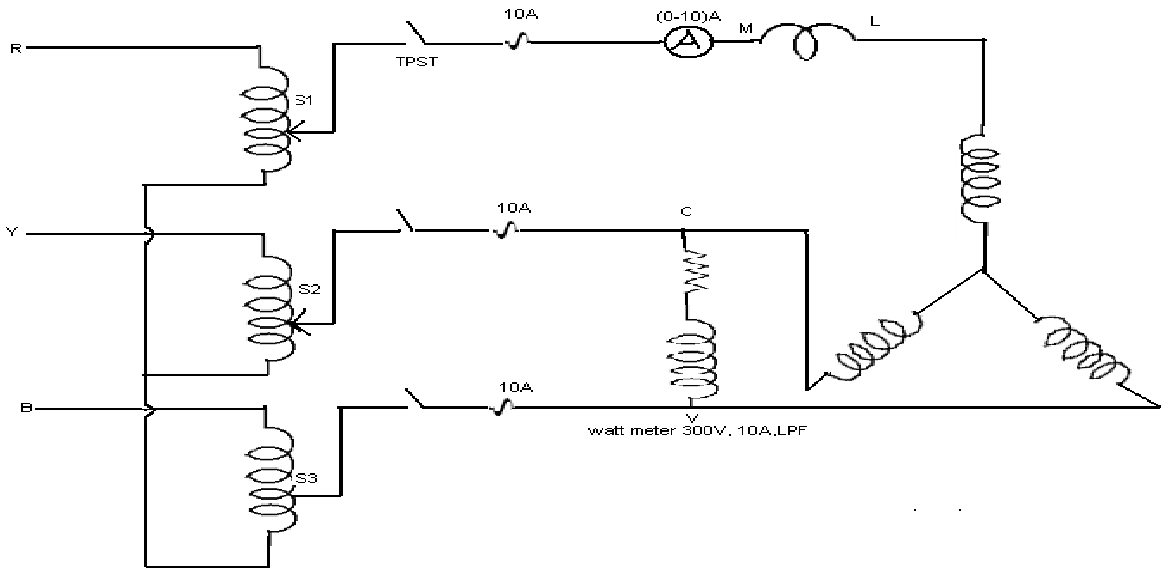
MEASUREMENT OF 3-Φ REACTIVE POWER WITH 1-Φ WATTMETER

AIM: To measure three phase reactive power with single phase wattmeter.

APPARATUS:

1. Three phase supply
2. Three phase variac
3. Three phase Inductive load (415V, 10A)
4. Single phase wattmeter (300V, 10A,LPF)
5. Voltmeter (0-300V)
6. Ammeter (0-10A)

CIRCUIT DIAGRAM:



PROCEDURE:

1. Make the connections as per the circuit diagram.
2. See that the variac is in the minimum output voltage position.
3. Switch on the supply with the help of TPST.
4. Vary the variac such that the voltmeter shows some reading (say 120V).
5. Note down the reading of wattmeter.

Wattmeter reading $W = V_{bc} I_a \cos(90-\Phi)$

$= V_L I_L \sin\Phi$

Reactive Power $= \sqrt{3}\ W = \sqrt{3}\ V_L\ I_L\ \sin\Phi$

$$\mathbf{Q = \sqrt{[3(VI)^2 - P^2}}$$

RESULT:

EXPERIMENT NO: **07** DATE:

MEASURMENT OF PARAMETERS OF CHOKE COIL BY (i) THREE AMMETER METHOD (ii) THREE VOLTMETER METHOD

AIM: To Measure the parameters of a choke coil using

(i) 3-ammeter method.

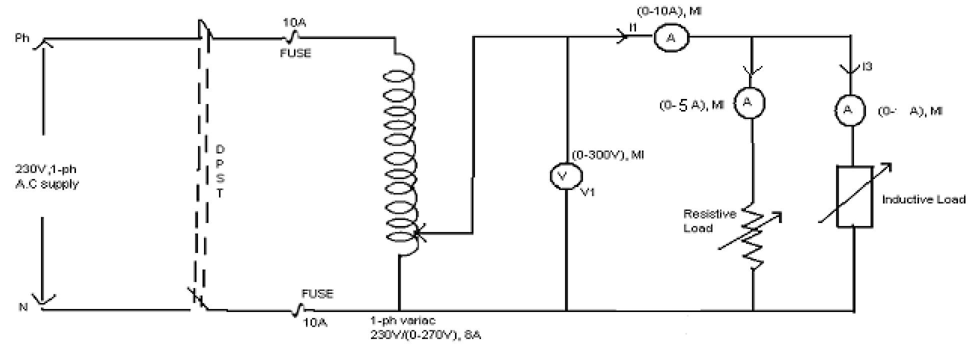
(ii)3-voltmeter method

APPARATUS:

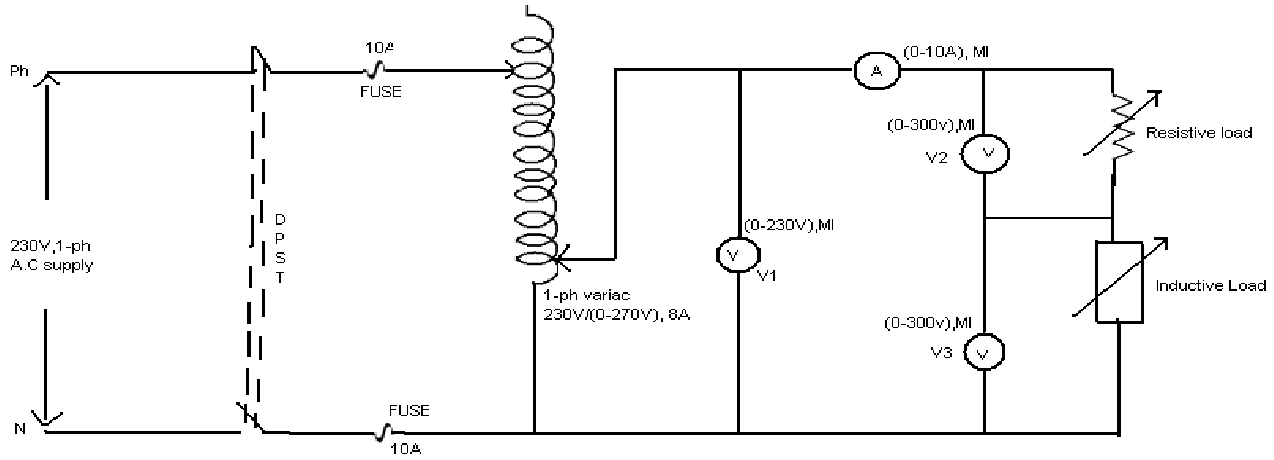
1. Ammeter (0-10A) MI -1
2. Ammeters (0-5A) MI -2
3. Voltmeter (0-300V) MI -3
4. Resistive load
5. Inductive load
6. Single phase variac (230V / 0-270V)
7. Rheostat (350Ω/1.2A

CIRCUIT DIAGRAM:

(i) **THREE AMMETER METHOD**



(ii) THREEVOLTMETER METHOD



THEORY:

(i) **THREE AMMETER METHOD**

The parameters of the choke coil can be measured using 3-voltmeters, 3-ammeters. Generally, in the case of A.C circuits as power factor is involved, power factor meter must be used for the measurement of p.f. But p.f of such circuits can also be measured by using 3-ammeters. In this experiment load comprising of resistance and inductance i.e. choke coil is used. Parameters of the choke coil can be measured by using three ammeters as follows. In this experiment the 3-ammeters are placed in series with resistor, inductor and supply. The phasor sum of ammeter readings (I2,I3) gives the total current I1,of the circuit. Power factor of the circuit is determined. Using the p.f the resistance and inductance of the choke coil are measured as follows.

(ii) THREEVOLTMETER METHOD

Generally, in the case of A.C circuits as power factor is involved in the expression for power, power factor meter must be used for the measurement of p.f. But p.f of such circuits can also be measured by using 3- voltmeter method. In this experiment load comprising of resistance and inductance i.e. choke coil is used. Parameters of the choke coil can be measured by using three voltmeters as follows. One voltmeter is connected across resistance and other is connected across inductance. The phasor sum of these two voltmeter readings fives the total voltage applied to the circuit. From the above calculations power factor of the circuit is determined. Using the p.f the resistance and inductance of the choke coil are measured as follows.

PROCEDURE:

(i) **THREE AMMETER METHOD**

1. Connections are made as per the circuit diagram.
2. Variac is kept at minimum output voltage position.
3. Supply is given to the circuit and by varying the variac, adjust the voltage across the voltmeter as 230V.
4. Keep the resistance in maximum at starting.
5. For different values of inductive load note down the 3-ammeter readings and voltmeter readings.

(ii) THREEVOLTMETER METHOD

1. Connect the circuit as per the circuit diagram.
2. Keep the variac in minimum output voltage position.
3. Keep the rheostat in maximum position.
4. Switch on the supply.
5. Note down the readings of all meters for different values of inductive loads.

TABULAR COLUMN:

(i) **THREE AMMETER METHOD**

S.No.	Supply Voltage (V)	Current through resistor (A)	Current through inductor (A)	Total Current I (A)	Power Factor (cosΦ)	Power consumed by choke coil, $P_L = VI_3\cos\Phi$ (W)	Total Power $P = P_R + P_L$ (W)	Resistance R (Ω)	Inductance L (H)	Power consumed by Resistance (W)

(ii) **THREE VOLTMETER METHOD:**

S.No.	Supply Voltage (V)	Voltage across resistor (V)	Voltage across inductor (V)	Current I (A)	Power Factor $\cos\Phi_L$	Power consumed by resistance $P_R = V_2 I$ (W)	Power consumed by the choke coil,	Total Power $P = P_R + P_L$ (W)	Resistance R_L (Ω)	Induct-ance L (H)	Resist-ance of the choke coil, r (Ω)

							$P_L = V_3 I \cos\Phi_L$ (W)				

THEORITICAL CALCULATIONS:

(i) **THREE AMMETER METHOD**

V= Supply Voltage

I_1= Current in the circuit

I_2= Current through the resistive load

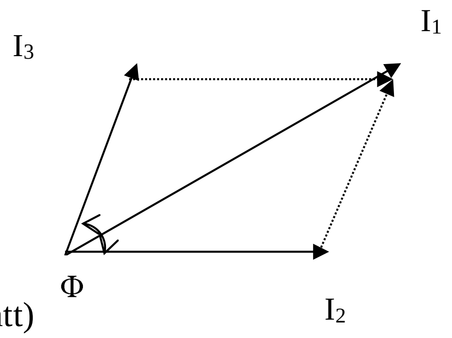
I_3 = Current through the inductive load

r= resistance of the choke coil

By parallelogram law

$I_1^2 = I_2^2 + I_3^2 + 2 I_2 I_3 \cos\Phi$

$\cos\Phi = (I_1^2 - I_2^2 - I_3^2) / (2 I_2 I_3)$



Power consumed by inductive load is

$P_L = V I_3 \cos\Phi_L$

Power consumed by resistive load is

$P_R = I^2 R$ (watt)

Total power consumed by load, $P = P_R + P_L$ (watt)

$r = P_L / I_3^2$ (ohm)

$Z_L = V / I_3$ (ohm)

$X_L = \sqrt{(Z^2 - r^2)}$ (ohms)

$L = X_L / 2\pi f$ H

(ii) **THREE VOLTMETER METHOD**

V_1= Supply Voltage

V_2= Voltage across resistive load

V_3= Voltage across inductive load

I = Current in the circuit

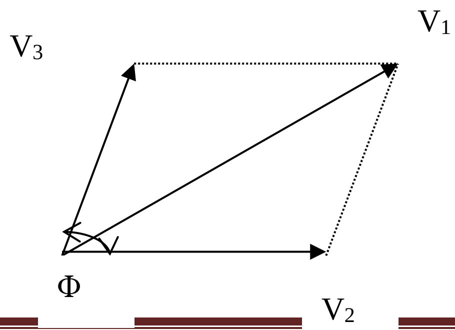
By parallelogram law

$V_1^2 = V_2^2 + V_3^2 + 2 V_2 V_3 \cos\Phi_\omega$

$\cos\Phi_\omega = (V_1^2 - V_2^2 - V_3^2)/(2 V_2 V_3)$

Power consumed by choke coil is

$P_L = V_2 I \cos\Phi_L$



Power consumed by resistive load is

$P_R = V_2 I$ (watt)

Total power, $P = P_R + P_L$ (watt)

Impedance in the circuit, $Z = V_3 / I$ (ohms)

Resistance = V_2 / I (ohms)

$P_L / I^2 = r$

Reactance, $X_L = \sqrt{(Z^2 - r^2)}$ (ohms)

Inductance in the circuit $L = X_L / (2\pi f)$ H

RESULT:

EXPERIMENT NO: **08** DATE:

CALIBRATION OF LPF WATTMETER BY PHANTOM TESTING

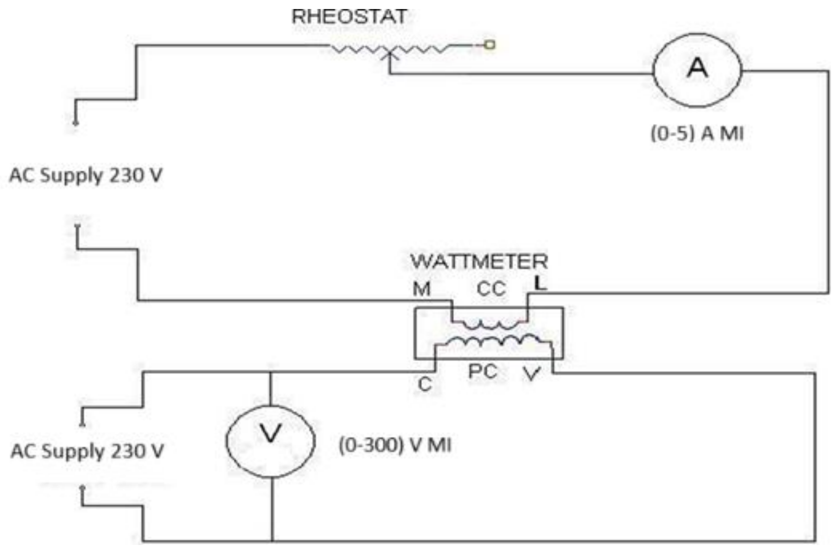
AIM:

To calibrate LPF wattmeter by phantom loading method and compare the power consumed with direct loading.

APPARATUS:

S. No	Equipment	Type	Range	Quantity
1	Auto Transformer			
2	Voltmeter			
3	Ammeter			
4	LPF Wattmeter			
5	Connecting wires			

CIRCUIT DIAGRAM:



Calibration of LPF Wattmeter by Phantom Testing

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 clockwisedirection.
5. Adjust the load rheostat so that sufficient current flows in the circuit. Please note that thecurrent should be less then potentiometer rating.
6. Note down the Voltmeter, Ammeter, Wattmeter for different voltages as per thetabular column.
7. Find out the percentage error by using above equations.

TABULAR COLUMN:

S. No	Voltage (V)	Ammeter (A)	Wattmeter (W)	VI	% Error
1					
2					
3					
4					

MODEL CALCULATIONS:

$$\% \text{ Error} = (W_M - W_C) * 100/ W_M$$

Where $W_C = VI$

RESULT:

EXPERIMENT NO: **09** DATE:

LVDT AND CAPACITANCE PICKUP-CHARACTERISTICS AND CALIBRATION

AIM:

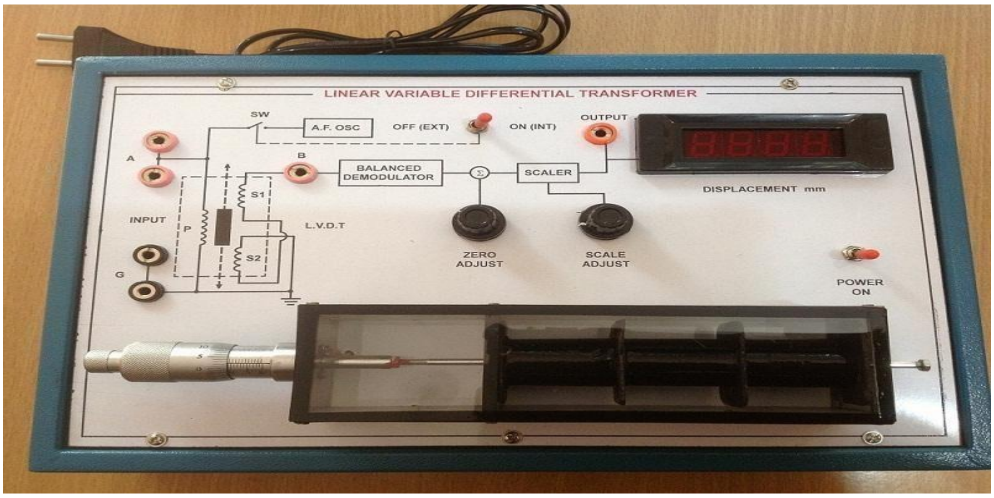
To measure the displacement using linear variable differential transformer.

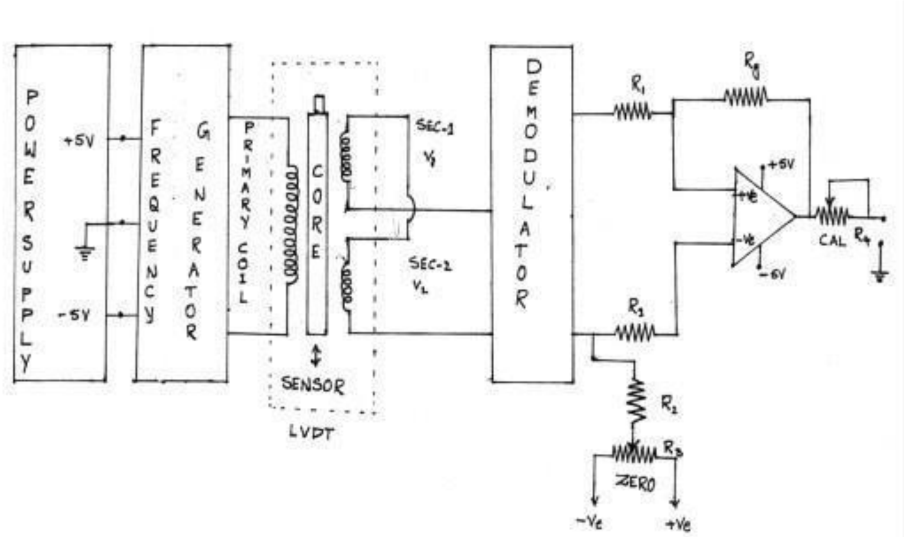
APPARATUS:

S. No	Name of Equipment	Specifications
1	LVDT	Trainer Kit

CIRCUIT DIAGRAM

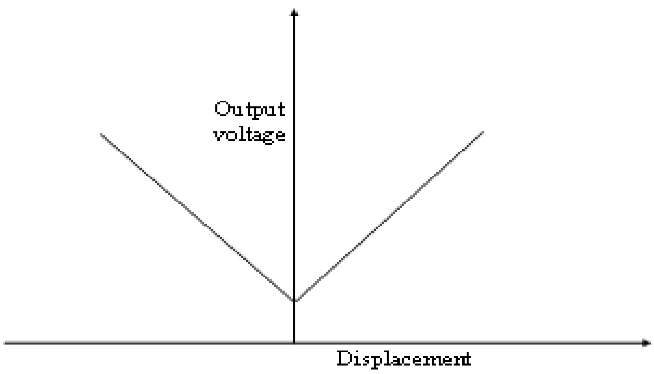
1) LVDT trainer kit:





Circuit Diagram of LVDT and Capacitance Pickup –Characteristics and Calibration

MODEL GRAPH:



PROCEDURE

1. Connections are made as per the circuit diagram.

2. Switch on the supply keep the instrument in ON position for 10 minutes for initial warm up.
3. Rotate the micrometer core till it reads 20.0 mm and adjust the CAL potentiometer to display 10.0 mm on the LVDT trainer kit.
4. Rotate the micrometer core till it reads 10.0 mm and adjust the zero potentiometer to display 20.0 mm on the LVDT trainer kit.
5. Rotate back the micrometer core to read 20.0 mm and adjust once again the CAL potentiometertill the LVDT trainer kit display reads 10.0 mm. Now the instrument is calibrated for 10mm range.
6. Rotate the core of micrometer in steps of 2 mm and tabulate the readings of micrometer, LVDTtrainer kit display and multimeter reading.

TABULAR COLUMN

S. No	Micro meter Reading in MM	Output Voltage
1		
2		
3		
4		
5		

RESULT:

EXPERIMENT NO: **10** DATE:

RESISTANCE STRAIN GAUGE- STRAIN MEASUREMENTS AND CALIBRATION

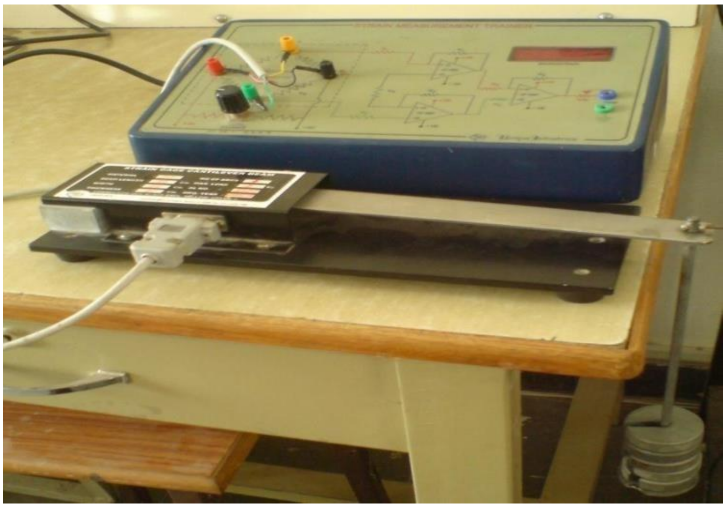
AIM:

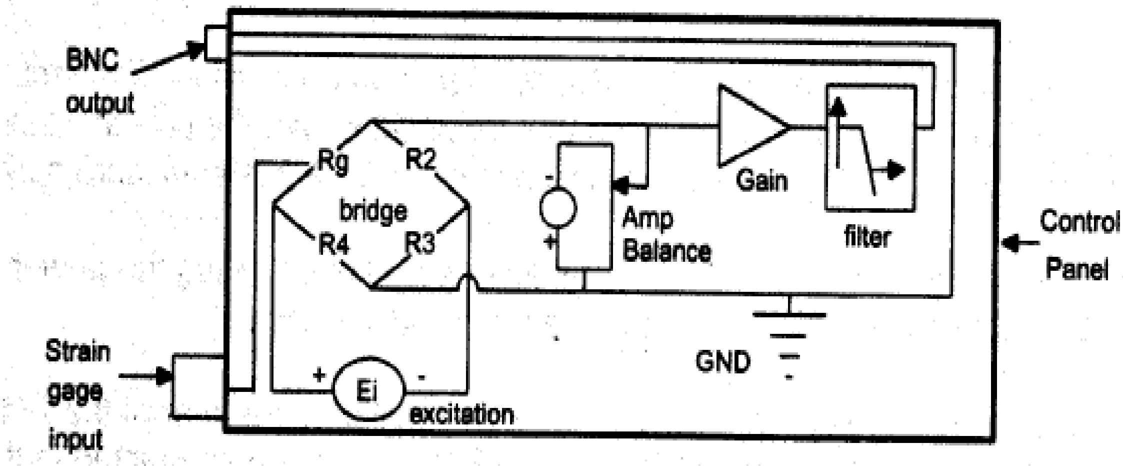
To measure the strain using strain gauge trainer kit

APPARATUS:

S. No	Name of Equipment	Specifications
1	Strain Gauge Trainer Kit	Trainer Kit

CIRCUIT DIAGRAM: Trainer Kit:





Circuit Diagram of Resistance Strain Gauge Strain Measurements and Calibration

PROCEDURE:

1. Check connection made and Switch ON the instrument by toggle switch at the back of thebox. The display glows to indicate the instrument is ON.
2. Allow the instrument in ON Position for 10 minutes for initial warm-up.
3. Adjust the ZERO Potentiometer on the panel till the display roads ‘OOP’.
4. Apply load on the sensor using the loading arrangement provided in steps of 100g upto 1 Kg.
5. The instrument display exact microstrain strained by the cantilever beam.
6. Note down the readings in the tabular column. Percentage error in the readings. Hysteresic and Accuracy of the instrument can be calculated by comparing with the theoretical values

TABULAR COLUMN:

S. No.	Weights	Actual Reading (A)	Indicating Reading(B)	%error= A-b/a*100
1				
2				
3				
4				
5				

MODEL CALCULATIONS:

S=(6pl) BT^{2}E

P = Load applied in Kg (1 Kg) – 0.2 kg

L = Effective length of the beam in Cms.

(22 Cms)B = Width of the beam (2.8 Cms)

T = Thickness of the beam

(0.25 Cm)E = Young's

modulus (2X10^6)

S = Micro strain

Then the micro strain for the above can be calculated as follows

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

$$S = 3.77 X 10^4$$

S = 377 micro strain

RESULT:

EXPERIMENT NO: **11** DATE:

DETERMINATION OF INDUCTANCE USING ANDERSON BRIDGE

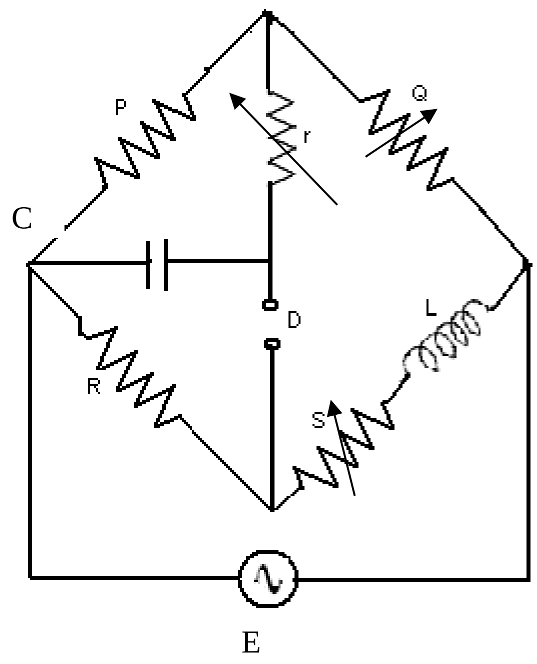
AIM:

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

APPARATUS:

S.no	Name of the equipment
1.	Head phones
2.	Probes
3.	Anderson Bridge
4.	galvanometer

CIRCUIT DIAGRAM:



PROCEDURE:

ADERSON BRIDGE:

D.C balance

1. Make the connections as shown in the figure, with DC supply, Galvanometer and one unknown inductance.
2. Adjust ‘r’ dial to 0Ω.
3. Now, adjust ‘R’ to same value and press the galvanometer.
4. Use resistance dial S only for fine balance in the galvanometer and note the value of R.

AC balance with head phones:

1. Replace the DC supply with AC supply of 1KHZ.
2. Replace galvanometer with head phones.
3. Set the standard capacitor ‘C’ at position 0.1μFand adjusts the resistance dial ‘r’ to minimize the sound in the head phone.
4. Note the value of r, R and C.
5. Now calculate the value of unknown inductance using the formula

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

6. Repeat the experiment with another value of unknown inductance and Capacitor C.

EXAMPLE:

R=46 OHMS

S=0.2 OHMS

P=Q=1000 OHMS

C=0.1µF

R=4400 OHMS

L=C*R(Q+2r)

=0.1E-6*46*9800

=45mH

RESULT:

EXPERIMENT NO: **12** DATE:

DETERMINATION OF SELF, MUTUAL INDUCTANCE AND COEFFICIENT OF COUPLING

AIM: To determine self, mutual inductance and coefficient of coupling of a mutually coupled circuit

APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity 1
1.	Ammeter			
2.	Voltmeter			
3.	1-phase Transformer			
4.	1-phase Variac			
5.	1-ph A.C. Supply			

6.	Connecting Wires			

CIRCUIT DIAGRAM:

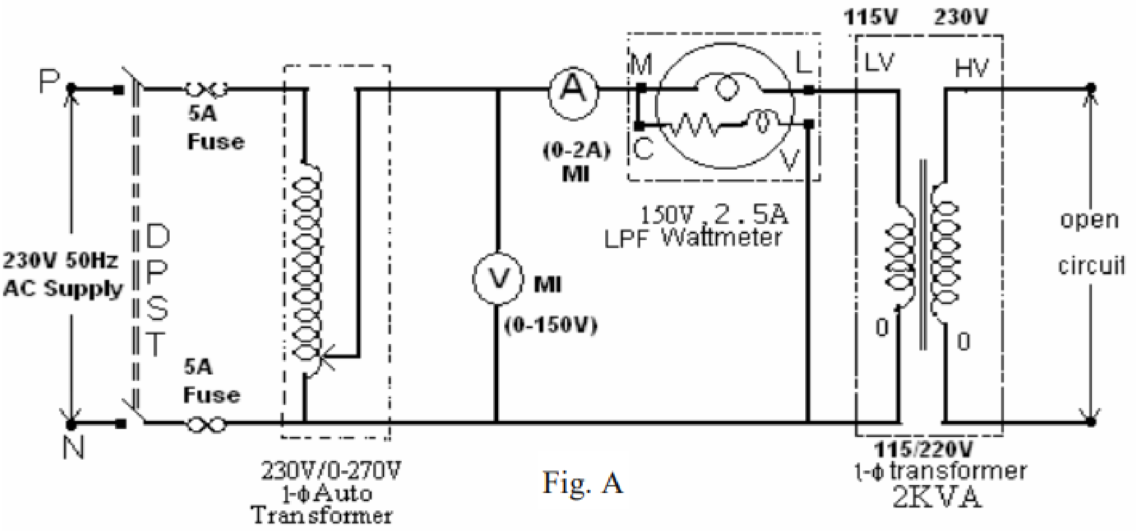


Fig. A

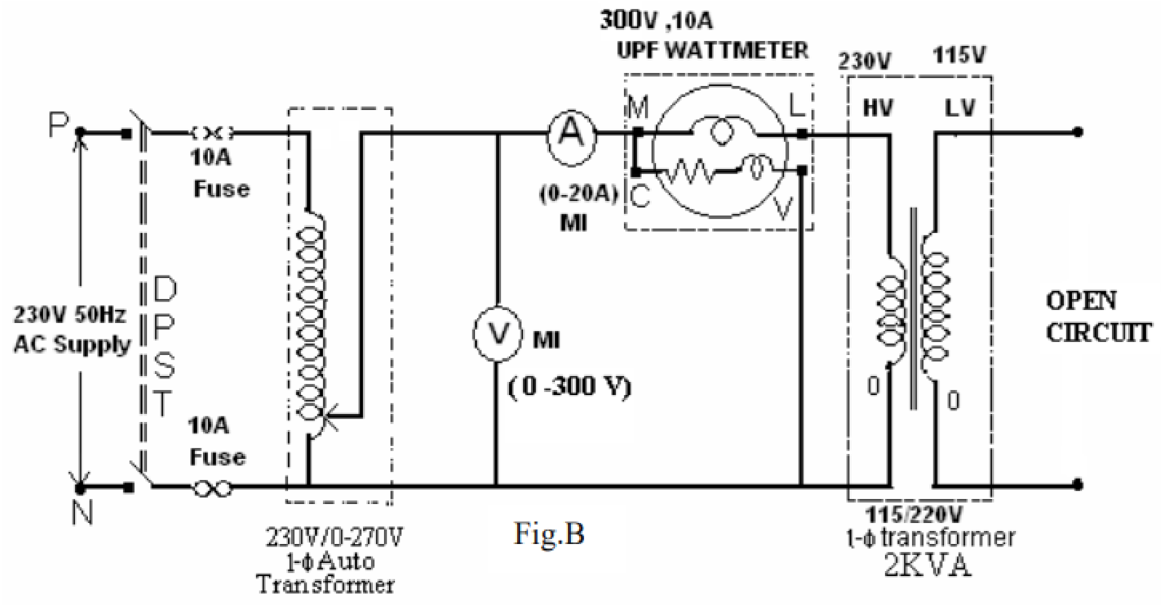


Fig.B

TABULAR COLUMN: For XL1

S.no	Voltmeter	Ammeter	XL1 =V/I

TABULAR COLUMN: For XL2

S.no	Voltmeter	Ammeter	XL2 =V/I

TABULAR COLUMN: For XLeq

S.no	Voltmeter	Ammeter	XLeq =V/I

THEORETICAL CALCULATIONS:

(Neglect winding resistance) $L_{eq} = L_1+L_2 \pm 2M$

Mutual Inductance $M=[(L_{eq} – (L_1+L_2))/2]$

Coefficient of Coupling $K = M/\sqrt{(L_1L_2)}$

Where L1 and L2 are determined as follows

Determination of L1 From fig.A

X_{L1}= voltmeter reading /ammeter reading

$X_{L1} = \omega L_1 = 2\Pi f L_1$ $L_1 = X_{L1}/2\Pi f$ (Henry)

Determination of L2 From fig B

X_{L2} = Voltmeter reading /Ammeter reading

$X_{L2} = \omega L_2 = 2\Pi f L_2$ $L_2 = X_{L2} / 2\Pi f$ (Henry)

Determination of Leq

X_{Leq} = Voltmeter reading /Ammeter reading

$X_{Leq} = \omega L_{eq} = 2\Pi f L_{eq}$ $L_{eq} = X_{Leq}/2\Pi f$ (Henry)

RESULTS: