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JAIPUR INSTITUTE OF TECHNOLOGY GROUP OF INSTITUTIONS ELECTRICAL LAB MANUAL OF ELECTRICAL MEASUREMENT LAB

Name: Roll No: Branch:

Signature of staff member

Contents:

1. DESAUTY'S BRIDGE

Objective:

To determine the unknown value of capacitance using Desauty’s bridge.

Apparatus:

Software: Lab view software.

Hardware: Name of the apparatus Quantity

Transformer 230/15v 1 No

Bread board 1 No

Resistors 5 No

Variable Resistor 1 No

Capacitors 1 No

Digital Multimeter 1 No

Theory:

The bridge is the simplest of comparing two capacitances. The connections and the phasor diagram of this bridge are shown below. Let

C_1 = Capacitor whose capacitance is to be measured.

C_2 = A standard capacitor

R_3, R_4 = Non-inductive resistors.

The balance can be obtained by varying either R_3 or R_4. Resistors R_1 and R_2 are

connected in series with C_1 and C_2 respectively. r_1 and r_2 are small resistances representing the loss component of the two capacitors.

At balance, $(R_1 + r_1 + 1/j\omega C_1) R_4 = (R_2 + r_2 + 1/j\omega C_2) R_3$

From which we have $C_1/C_2 = R_4/R_3$. Figure b shows the phasor diagram of the bridge

under balance conditions. The angles δ_1 and δ_2 are the phase angles of capacitors $C_1$and C_2 respectively.

Dissipation factor for the capacitors are $D_1 = \tan \delta_1 = \omega C_1 r_1$ and $D_2 = \tan \delta_2 = \omega C_2 r_2$

$D_2 – D_1 = \omega C_2(R_1 R_4/R_3 – R_2)$

Therefore, if the dissipation factor of one of the capacitors is known, the dissipation factor for the other can be determined.

Procedure:

1. Connect the circuit as shown in the figure.
2. Connect the unknown capacitor in C1.
3. Select any value of R3.
4. Connect the multimeter between ground and output of imbalance amplifier.
5. Vary R2, from minimum position, in clockwise direction.
6. If the selection of R3 is correct the balance point can be obtained at minimum position.
7. If that is not the case, select another R3.
8. Since, the unknown capacitance whose resistive effect would be made for capacitive form and R2 is adjusted for minimum output.

Observation:

S.NO

R3

R2

C2

$C1 = R2C2/R3$

True value of

C1

0

Result:

The unknown capacitance is determined using the Desauty’s bridge.

2. ANDERSON’S BRIDGE

Objective:

To determine the unknown value of inductance using Anderson's bridge.

Apparatus:

Software: Lab view software.

Hardware:

Name of the apparatus	Quantity
Transformer 230/15v	1 No
Bread board	1 No
Resistors	6 No
Variable Resistor	2 No
Capacitors	1 No
Inductors	1 No
Digital Multimeter	1 No

Theory

In this bridge, the self inductance is measured in terms of a standard capacitor. This method is applicable for precise measurement of self-inductance over a very wide range of values. Figures below show the connections and the phasor diagram of the bridge for balanced conditions.

Let L_1 = self inductance to be measured, R_1 = resistance of self-inductor,

r, R_2, R_3, R_4 = known non-inductive resistance r_1 = resistance connected in series with self-inductor,

At, balance, $I_1 = I_3$ and $I_2 = I_C + I_4$.

Now, $I_1 R_3 = I_C / j\omega C$ therefore, $I_C = I_1 j\omega C R_3$.

Writing the other balance equations.

$I_1(r_1 + R_1 + j\omega L_1) = I_2 R_2 + I_C r$ and $I_C(r + 1/j\omega C) = (I_2 - I_C) R_4$

By substituting I_C value and equating real and imaginary parts

$R_1 = R_2 R_3 / R_4 – r_1$

$L_1 = C R_3/R_4\{ r(R_4+R_2)+R_2 R_4\}$

Procedure:

1. Connect the circuit as shown in the figure.
2. Connect the unknown inductance in L1.
3. Select any value of r.
4. Connect the multimeter between ground and output of imbalance amplifier.
5. Vary r1 and r, from minimum position, in clockwise direction.
6. Calculate the inductance L1 by substituting known values.

Observation:

Actual value of L in mH

R in ohms

Practical value of L in mH

Result:

The unknown inductance is determined using the Anderson's bridge.

3. OWEN'S BRIDGE

Objective:

Measurement of inductance in terms of a standard capacitor using Owen’s bridge.

Apparatus:

Software: Lab view software.

Hardware: Name of the apparatus Quantity

Transformer 230/15v 1 No

Bread board 1 No

Resistors 2 No

Variable Resistor 1 No

Capacitors 2 No

Inductors 1 No

Digital Multimeter 1 No

Theory

This bridge is used for measurement of an inductance in terms of capacitance.

Let L1 = unknown self-inductance of resistance R1, R3 = fixed non-inductive resistance, R2 = variable non-inductive resistance, C4 = fixed standard capacitor,

C2 = variable standard capacitor.

At balance, (R1+jωL1)(1/jωC4) = (R2 + 1/jωC2) R3.

Separating the real and imaginary terms, we obtain: L1 = R2R3C4 and R1 = R3C4/C2.

Procedure:

1. Connect the circuit as shown in the figure.
2. Connect the unknown inductance in L1.
3. Select any value of R1, R4 and C3..

4. Connect the multimeter between ground and output of imbalance amplifier.

5. Vary R1 and R4, from minimum position, in clockwise direction.

6. If the bridge does not balance change the value of C3.

7. Calculate the inductance L1 by substituting known values.

Observation:

S.NO

R2

R4

C3

L1= R2C3R4

True value of

L1

Result:

Actual and practical values of Inductances are found to be nearly equal.

4.MAXWELL'S INDUCTANCE BRIDGE

Objective:

To determine the unknown value of inductance by comparing with a variable standard self inductance using Maxwell's Inductance bridge.

Apparatus:

Software: Lab view software.

Hardware: Name of the apparatus Quantity

Transformer 230/15v 1 No

Bread board 1 No

Resistors 4 No

Variable Resistor 1 No

Inductors 2 No

Digital Multimeter 1 No

Theory:

This bridge circuit measures an inductance by comparison with a variable standard self- inductance. The connections and the phasor diagrams for balance conditions are shown below.

Let, L1 = unknown inductance of resistance R1,

L2 = variable inductance of fixed resistance r2,

R2 = variable resistance connected in series with inductor L2,

R3, R4 = known non-inductive resistances.

At balance, L1 = R3L2/R4 , R1= R3(R2+r2)/R4.

Procedure:

1. Connect the circuit as shown in the figure.
2. Connect the unknown inductance in L1.
3. Connect the multimeter between ground and output of imbalance amplifier.
4. Vary R2, from minimum position, in clockwise direction.
5. If the selection of R2 is correct the balance point can be obtained at minimum position. 6. Vary R2 for fine balance adjustment.

Observation:

S.NO

R2

R3

C1

L1= R3L2 / R4

True value of

L1

Result:

Actual and practical values of Inductances are found to be nearly equal.

5. MAXWELL'S INDUCTANCE CAPACITANCE BRIDGE

Objective:

To determine the unknown value of inductance by comparing with a standard variable capacitance using Maxwell's Inductance Capacitance bridge.

Apparatus:

Software: Lab view software.

Hardware: Name of the apparatus Quantity

Transformer 230/15v 1 No

Bread board 1 No

Resistors 3 No

Variable Resistor 1 No

Inductors 1 No

Capacitor 1 No

Digital Multimeter 1 No

Theory:

This bridge circuit measures an inductance by comparison with a standard variable capacitance . The connections and the phasor diagrams for balance conditions are shown below.

Let, $L1$ = unknown inductance of resistance $R1$, $R2, R3, R4$ = known non-inductive resistances

$L2$ = variable inductance of fixed resistance $r2$, $C4$ = variable standard capacitance.

Writing the equation for balance

$(R1+j\omega L1)(R4/1+j\omega C4R4) = R2R3$

Separating the real and imaginary terms, we have

$R1 = R2R3/R4$ and $L1 = R2R3C4$

Procedure:

1. Connect the circuit as shown in the figure.
2. Select the value of R2.
3. Vary R3 from minimum position in clockwise direction.
4. If the selection of R2 is correct, the balance point is observed at minimum voltage, for a particular R1 and then increases by varying R3 in the same clockwise direction. If that is not the case, select another value of R2.
5. Vary R3 for fine balance adjustment.
6. Observe the balance of bridge either using loud speaker or digital multimeter.
7. Connect the digital multimeter at the output of the detector. Alternately, adjust R3 and proper selection of R2.

Observation:

S.NO

R2

R3

C1

L1= R2R3 C4

True value of

L1

Result:

Actual and practical values of Inductances are found to be nearly equal.

6.CALIBRATION OF 1 – PHASE ENERGY METER

Objective:

To calibrate an Energy meter by phantom loading method.

Apparatus:

Hardware: Name of the apparatus Quantity

1-ph Energy meter, 230V, 5-10A 1 No

Digital Wattmeter, U.P.F. type 0-300 kw 1 No

Digital Voltmeter, 0-300V 1 No

Digital Ammeter, 0-10V A 1 No

1-ph Auto-transformer, 2 Amps 1 No

Stop watch 1 No

Theory :

The calibration of energy meter becomes inaccurate during its rigorous use due to various reasons. It is necessary to calibrate the meter to determine the error, so that same meter can be used for correct measurement of energy.

Phantom loading is performed in this experiment because the current rating of the meter under test is high. The driving system of the meter consists of current coil connected in series with load and shunt coil connected in parallel to the supply. The moving system consists of a non-magnetic material and light material i.e aluminum disc. This disc is positioned in the air gap between series and shunt magnets. A permanent magnet is positioned near the edge of the aluminum disc, which forms the braking system. At steady speed of the disc, the driving torque is equal to the braking torque.

For 1200 rev. the meter reads 1 KWh

So, for x revolutions the meter reads x/1200 KWh

% error in speed = Actual r.p.m – True r.p.m x 100

Actual r.p.m

% error in measurement =

Measured Energy in kwh – Actual energy in kwh x 100

Measured Energy in kwh

No .of revolutions in given time Nth = T x P

3000

% error = Nth - Na x 100 (in watts)

Nth

Procedure :

1. Connect the circuit as shown in figure 2. Keep the auto transformer at zero position.

3. Increase the current in the current coil of the energy meter till the current reaches its maximum value of 5A.

4. Ensure the direction of the rotation of the disc in the energy meter as per the direction marked.

5. Record the time and wattmeter reading for every 10 revolution at different values of current.

Observation:

S.No

V

(volts)

I

(amps)

P

(KW)

Time for 10

Rev. 1 sec

No. of Rev. in Time

% error

Result :

The given energy meter is calibrated using calibrated wattmeter, voltmeter and ammeter.

7. CALIBRATION OF POWER FACTOR METER

Objective:

To calibrate the given power factor meter using calibrated voltmeter, ammeter and wattmeter.

Apparatus:

Hardware: Name of the apparatus Quantity

0.5 lead to 0.5 lag power factor meter 1 No

3.0kw, u.p.f. digital wattmeter 1 No

0-10 amps digital ammeter 1 No

230 v rated resistive, inductive 1 No

Theory: 0-300 volts digital voltmeter 1 No

The power factor of an a.c circuit can be calculated using the relationship Cos θ = P/VI.

This method of determining the power factor of an electric circuit is however,of low accuracy and has several disadvantages. It is difficult to find out the instantaneous p.f. value by this method. Power factor meters have deflection force and controlling force only.

There are two types of power factor meters.

(a) Electro dynamo meter type (b) Moving Iron type

These meters posses a current coil circuit and a pressure coil circuit. The pressure coil circuit connected across the supply lines is split up into two parallel paths. One inductive and the other is resistive. The deflection of the instrument depends upon the phase difference between the main current and currents in the two coils.

The accuracy obtained with the use of power factor meters is sufficient for most of the purposes, other than the precision testing.

The power factor meter may become inaccurate during the period of its use due to several reasons. Hence, it is to be calibrated, periodically.

Procedure :

1. Connect the circuit as per the circuit diagram.

2. Keep the auto-transformer at zero position and switch ON the supply.

3. Switch ‘ON’ the resistive (bulb), inductive (choke) and capacitive loads with different combinations.

4. Note down the ammeter, voltmeter, wattmeter and power factor meter readings at different current values. 5. Switch ‘OFF’ the supply and load switches.

Observation:

Load

Vth

(volts)

I

(amps)

P

(KW)

Cosθ

(observed)

Cosθ

(theoretical)

% Error

Sample Calculations:

$$\text{Cos}\theta \text{ th} = \frac{P}{VI}$$ and $$\% \text{ error} = \frac{\text{Cos}\theta\text{(observed)} - \text{Cos}\theta\text{(theoretical)}}{\text{Cos}\theta\text{(theoretical)}}$$

Result :

The given P.F meter is calibrated by using a calibrated ammeter, voltmeter and wattmeter.

8. MEASUREMENT OF PARAMETERS OF A CHOKE COIL

USING 3 VOLTMETER AND 3 AMMETER METHOD

Objective:

Measurement of power consumed, power factor and inductance of a choke by 3 – Voltmeter & 3 – Ammeter method.

Apparatus:

Hardware: Name of the apparatus Quantity

2 Amps, Auto – transformer 1 No

0 -300 V, A.C. Voltmeter 1 No

0 – 2 A, A.C. Ammeter 1 No

Load – Choke 1 No

Theory :

Power consumed in any circuit can be measured without a wattmeter by using either with 3 Voltmeters or 3 Ammeters.

Three Voltmeter method : In this method, three voltmeters and a known non inductive resistance is used. This resistance is connected in series with the load.

As shown in the circuit one voltmeter is used in the experiment to measure the supply voltage V1, Voltage V2 across the resistance and voltage V3 across the load (choke).

The circuit diagram and phasor diagram are as shown below.

As per the phasor diagram

V12 = V22 + V32 +2V2V3 Cos θ

Therefore Cos θ = V12 - V22 - V3 2

2V2V3

The power consumed in the load is V3 I Cos θ

Where as I = V2 = (such that V2 = IR)

R

Hence, PL = V3 V2 x V12 - V22 - V32

R 2V2V3

PL = V12 - V22 - V32

2R

Three Ammeter Method :

In this method three numbers of ammeters are used. A known resistance is connected in parallel to the load.

Where as, in this experiment one ammeter and 3 nos. of ON/OFF toggle switches are used to measure.

(a) Current drawn from the supply I1, (b) Current through the resistance I2 and (c) Current through the load I3.

Procedure :

Three Ammeter Method :

1. Connect the circuit as shown in figure
2. Set the Auto transformer at zero position
3. The toggle switch is in ON condition when ammeter is connected in the circuit and then close the switch after the reading was taken.
4. One voltmeter is connected across the load.
5. Increase the supply gradually till the current through the load is its rated current 0.45 amps.
6. Record I1, I2 and I3 at various VL values.
7. Switch off the supply.

Calculations :

Cos θ = V 12 - V22 - V32

or

(I12 –I22 –I32) X R

2V2V3 2

PL = VI3 Cos θ = I32 RL where r = resistance of the choke

ZL = V where as X L2 = Z L2 – R L2

R

L = XL

2πf

Hence the L value of the choke = Henerys.

As per the phasor diagram,

I12 = I22 +I32 +2 I2 I3 Cos θ

Therefore Power factor Cos θ = (I12 –I22 –I32)

2I2I3

Power consumed in the load PL = (I12-I22-I 32)X R

2

Procedure :

1. Connect the circuit as shown in figure.

2. Set the Auto transformer at zero position.

3. Close S1, S3 switches and open S2, S4 switches.

4. Increase the input supply gradually and note down the readings V1, V2 and V3. The voltage across the load shall not be increased beyond its rating.

5. Tabulate the values as shown in the table.

6. Switch off the supply.

Circuit Diagram for 3-Ammeter Method

Circuit Diagram for 3 - Voltmeter Method

Observations:

3 – Voltmeter Method:

S.No

VS

(volts)

VR

(volts)

VL

(volts)

COS θ

PL

(watts)

3 – Ammeter Method :

S.No

VL

(volts)

Is

(amps)

IL

(amps)

IR

(amps)

PL

(watts)

COS θ

Result:

Hence measurement of power consumed, power factor and inductance of a choke by 3-voltmeter or 3-ammeter method.

9.MEASUREMENT OF 3 – PHASE POWER BY 2- WATTMETERS

Objective:

Measurement of power by 2-wattmeters for balanced loads in a 3-phase circuit .

Apparatus:

Hardware: Name of the apparatus Quantity

32 Amps, 3 pole Fuse Switch 1 No

0 -300 W, U.P.F. Wattmeters 1 No

0 – 10 A, Ammeter 1 No

0-300 V, Voltmeter 1 No

Theory :

In a 3-phase, 3-wire system, power can be measured using two watttmeters for balance and unbalanced loads and also for star, delta type loads.

This can be verified by measuring the power consumed in each phase. In this circuit, the pressure coils are connected between two phase such that one of the line is coinciding for both the meters.

$P1 + P2 = 3\ VPh\ IPh\ COSø$

Power factor $Cosø = Cos (tan-1 √3 ((P1 –P2)/(P1 +P2)))$

Procedure:

a) Connect the circuit as shown in the circuit diagram.

b) Keep all the toggle switches in ON condition.

c) Switch on equal loads on each phase i.e. balanced load must be maintained with different load combinations.

d) Connect the ammeter in R-Phase and then switch OFF the toggle switch connected across the ammeter symbol.

e) Connect the pressure coils of two wattmeter across R-Y phase and B-Y phase respectively, current coil in R-phase and B-phase .

f) For different balanced loads take readings of wattmeters W1 and W2.

Circuit Diagram:

Observations:

Type of Load (W)	W1 KW	W2 KW	I1 Amps	I2 Amps	Vph Volts	W1+ W2 KW P KW

R	Y	B	W1	W2	IR	IB	Vph	(W1+ W2)
X2	P							
KW								

Result:

Measurement of power by 2-wattmeters for balanced loads in a 3-phase circuit is determined.

10.MEASUREMENT OF ACTIVE AND REACTIVE POWER BY

1- WATTMETER METHOD

Objective:

Measurement of active and reactive power using 1-wattmeter at different R, L & C loads.

Apparatus:

Hardware: Name of the apparatus Quantity

32 Amps, 3 pole Fuse Switch 1 No

0 -300 W, U.P.F. Wattmeters 1 No

0 – 10 A, A.C Ammeter 1 No

0-300 V, A.C Voltmeter 1 No

Theory:

The active power is obtained by taking the integration of function between a particular time interval from t1 to t2

t2

P = 1/(t2- t1) P(t) dt

t1

By integrating the instantaneous power over one cycle, we get average power.

The average power dissipated is

$P_{av} = V_{eff}[\ I_{eff} \cos\theta]$

From impedance triangle,

$\cos\theta = R/Z$

Substituting, we get

Reactive Power $P_r = V_{eff}[\ I_{eff} \sin\theta]$

Active power measurement:

Reactive power measurement:

Procedure:

g) Connect the circuit as shown in the circuit diagram.

h) Keep all the toggle switches in ON condition.

i) Switch on equal loads on each phase i.e. balanced load must be maintained with different load combinations.

j) Connect the ammeter in R-Phase and then switch OFF the toggle switch connected across the ammeter symbol.

k) Connect the pressure coil of the wattmeter across R-Y phase and current coil in R-phase to measure active power.

Observations:

Load: Balanced load

Type of the load	Vph	IL	Pph	Pactual

P = 3x Pph Cos θ

=P/ (√3 VL IL)

Result:

Active and Reactive powers were measured using 1-wattmeter at R, L and C Loads.

11.HAY'S BRIDGE

Objective:

To measure the unknown inductance value of high Q inductor.

Apparatus:

Name of the apparatus	Quantity
1. Lab trainer kit	01
2. Multimeter	01
3. Unknown inductor	01

Theory:

The Hay's Bridge differs from Maxwell's bridge by having resistor R1 in series with standard capacitor C1 instead of in parallel. It is immediately apparent that for large phase angles, R1 should have a very low value. The Hay's circuit is therefore more convenient for measuring high Q coils.

The balance equations are again derived by substituting the values of the impedance of the bridge arms into the general equation for bridge balance. On separating real and imaginary terms, the balance equations are:

$R1Rx+Lx/C1 = R2R3$ ------------- (1)

$Rx/\omega C1 = \omega LxR1$ --------------- (2)

Both equations 1 & 2 consist of L & R. By solving the above equations

Rx = --------------- (3)

Lx = --------------- (4)

The expressions for the unknown inductance & resistance are consists of frequency term under balanced condition when two phase angles are equal, their tangents are also equal. Hence,

$\tan\theta L = \tan\theta C$ (or) Q = -------- (5)

Substituting (5) in (4)

So, Lx = , but for high values of Q (i.e.) Q > 10 the term is negligible.

So, Lx = R2R3C1

The Hay's bridge is suited for the measurement of high-Q inductors, especially for those

inductors having a Q greater than ten. For Q-values smaller than ten the term becomes important & cannot be neglected. In this case, Maxwell's bridge is more suitable.

Phasor Diagram :

Procedure:

1. Switch ON the trainer & check the power supply.
2. Connect the unknown value of inductance (high Q) in arm marked Lx.
3. Vary R2 for fine balance adjustment.
4. The balance of bridge can be observed by using head phone. Connect the output of the bridge at the input of the detector.
5. Connect the head phone at output of the detector, alternately adjust R1 and proper selection of R3 for a minimum sound in the head phone.
6. Finally disconnect the circuit and measure the value of R1 at balance point using any multimeter. By substituting R1, R3 and C1 the unknown inductance can be obtained.

Observations:

S.No.	R2 (KΩ)	R3 (Ω)	C1 (μF)	Lx (mH)	L mH

Result:

After balancing the bridge, the values of R1 R3 and C1 are measured and found that the calculated value of Lx is almost equal to the actual value.

12.WHEATSTONE'S BRIDGE

Objective:

To determine the unknown value of resistance using wheatstone's bridge.

Apparatus:

Software:

Lab view software.

Hardware: Name of the apparatus Quantity

Name of the apparatus	Quantity
Bread board	1 No
Resistors	3 No
Variable Resistor	1 No
Digital Multimeter	1 No

Theory :

The bridge consists of four resistive arms together with a source of e.m.f. and null detector. The galvanometer is used as a null detector. When the bridge is balanced, the galvanometer carries zero current and it does not show any deflection. Thus bridge works on the principle of null deflection or null indication.

To have zero current through galvanometer, the points B and D must be at the same potential. Thus potential across arm AB must be same as the potential across arm AD.

Thus $I_1R_1 = I_2 R_4$

As galvanometer current is zero,

$I_1 = I_3$ and $I_2 = I_4$

Considering the battery path under balanced condition,

$I_1 = I_3 = E/(R_1+R_2)$

And $I_2 = I_4 = E/(R_3+R_4)$

Therefore $R_1(R_3+R_4) = R_4(R_1+R_2)$

$R_1 = R_2R_4/R_3$

Procedure:

1. Connect the circuit as shown in the figure.
2. Select any value of R1.
3. Connect the multimeter between ground and output of imbalance amplifier.
4. Vary R3, from minimum position, in clockwise direction.
5. If the selection of R1 is correct the balance point can be obtained at minimum position.
6. If that is not the case, select another R1.
7. Calculate the Resistance R1 by substituting known values.

Observation:

S.No	R1	R2	R3	R4

Block Diagram in Labview:

Front Panel in Labview:

Result:

Hence the balanced condition of wheatstone's bridge is obtained and unknown values of resistances are found.

13.SCHERING'S BRIDGE

Objective:

To determine the unknown value of capacitance using schering's bridge.

Apparatus:

Software:

Lab view software.

Hardware: Name of the apparatus Quantity

Name of the apparatus	Quantity
Bread board	1 No
Resistors	2 No
Variable Resistor	1 No
Capacitors	3No
Digital Multimeter	1 No

Theory:

Schering bridge is one of the most important of the a.c. bridge. It is extensively used in measurement of capacitance.

At balance, $\{r_1 + 1/(j\omega C_1)\}\{R_4/(1+j\omega C_4 R_4)\} = R_3/(j\omega C_2)$

$\{r_1 + 1/(j\omega C_1)\} R_4 = R_3/(j\omega C_2) * \{(1+j\omega C_4 R_4)\}$

$r_1 R_4 – \{(jR_4)/(\omega C_1)\} = \{(-jR_3)/(\omega C_2)\} + \{(R_3 R_4 C_4)/(C_2)\}$

Equating real and imaginary terms, $r_1 = R_3 C_4/C_2$ and $C_1 = C_2 R_4/R_3$

Procedure:

1. Connect the circuit as shown in the figure.
2. Select any value of C1.
3. Connect the multimeter between ground and output of imbalance amplifier.
4. Vary R4 and C4, from minimum position, in clockwise direction.
5. If the selection of C1 is correct the balance point can be obtained at minimum position.
6. If that is not the case, select another C1.

7. Calculate the Capacitance by substituting known values.

Observation:

C4	C1	C2	R3	R4

Block Diagram in Labview:

Front Panel in Labview:

Result:

Hence the balanced condition of schering bridge is obtained and unknown value of

capacitance is found.

14.WATER FLOW GAUGE USING ARDUINO

Aim:To measure flow of water using water flow gauge and Arduino

Apparatus:

i) Arduino UNO

ii) Flow sensor

iii) Three-core cable

iv) Three-way line plug and socket

v) Container

vi) Pipe

vii) 5v Supply for sensor

Introduction: Both gas and liquid flow can be measured in volumetric or mass flow rates, such as liters per second or kilograms per second. When gases or liquids are transferred for their energy content, such as the sale of natural gas, the flow rate may also be expressed in terms of energy flow, such as GJ/hour or BTU/day. The energy flow rate is the volume flow rate multiplied by the energy content per unit volume or mass flow rate multiplied by the energy content per unit mass. Where accurate energy comes to the time of the legit flow rate is desired, most flow meters will be used to calculate the volume or mass flow rate which is then adjusted to the energy flow rate by the use of a flow computer.

The volumetric flow rate is usually given the symbol, and the mass flow rate, the symbol.

Liquid

For liquids, various units are used depending upon the application and industry, but might include gallons per minute, liters per second or, when describing river flows, cubic metres per second or acre-feet per day. In oceanography a common unit to measure volume transport volume of water transported by a current for example is a sverdrup (Sv) equivalent to 106 m3 / s

Water Flow:

Water flow in this project is created by the water pumping out through the pipe from the container. The flow sensor is connected in between the water flow pipe as shown

Sensor connection

Water flow sensor:

Water Flow Sensor is the latest sensor, which mainly consisting of a) Plastic valve.

b) Water flow rotor parts

c) Hall sensor.

Internal design of sensor

Operating Principle of sensor

The sensor sit in line with water line and the water flow pushes the rotor vanes. It uses a pinwheel sensor to measure how much liquid has moved through it. The pinwheel has a little magnet attached, and there's a hall-effect magnetic sensor on the other side of the plastic tube that can measure how many spins the pinwheel has made through the plastic wall. This method allows the sensor to stay safe and dry. 11

Its magnetic rotor turns and the speed responds to changes in flow rate. And the Hall sensor outputs corresponding pulse signals, and returns them to the controller; and then the controller judges the flows of water and controls.

Hall effect principle

The sensor comes with three wires: i) Red (5-24VDC power),

ii) Black (ground) and

iii) Yellow (Hall-effect pulse output).

By counting the pulses from the output of the sensor, we can easily track fluid movement Application:

It is applied in the Measurement and Control System for water flow, like the intake end of water heater

MegunoLink software

MegunoLink is a free program to upload compiled binary files to the Arduino micro controller and monitor communications from the device. It allows you to go away from the simple Arduino development environment and use a more full featured 20 environment. MegunoLink can graphdata sent from the Arduino to your PC, log serial data to a text-file or a monitorwindow, and can simulate serial protocols for missing devices.

Determinig the Calibration Factor:

A bucket and a stopwatch is an analogy for determing the calibration factor.The stopwatch is started when the flow starts, and stopped when the bucket reaches its limit say 1litre. The volume divided by the time gives the flow rate. For continuous measurements, we need a system of continually filling and emptying buckets to divide the flow without letting it out of the pipe. These continuously forming and collapsing volumetric displacements may take the form of pistons reciprocating in cylinders, gear teeth mating against the internal wall of a meter or through a progressive cavity created by rotating oval gears or a helical screw.

90 sec min

1 litre/ m /(2/3) =963 pulses/min

This means our scaling factor to convert pulses per second into liters per minute is 1/963. By measuring the pulse frequency and dividing by 963 we can determine the current flow rate in liters per minute.

Flow rate = no. of pulses * calibration factor

RESULTS AND GRAPH IN MEGUNO LINK

Graph in meguno link for differt flow rates

Graph in Meguno for constant flow rate

RESULTS:

15.WATER TANK DEPTH SENSOR USING ARDUINO-LABVIEW INTERFACE

Aim: To demonstrate water level measurement and control

Apparatus:

1. Relay 2. Float
3. Pump
4. Transistor
5. Resistor
6. 12V Adapter

7. 7805 Voltage regulator

8. Water tanks

9. Connecting wires

10. PCB

LABVIEW ARDUINO INTERFACE

The LabVIEW Interface for Arduino (LIFA) provides an interface between LabVIEW and an

Arduino. LIFA was developed and tested using an Arduino Uno but should work with most Arduino compatible hardware. The LabVIEW Interface for Arduino includes opens source firmware for the Arduino as well as over 100 VIs to access the Arduino functionality from within LabVIEW. LIFA is a tethered solution and requires a data connection between LabVIEW and the Arduino at all times. This is typically accomplished via USB but can also be accomplished using Xbees or bluetooth. LIFA does not allow the user to deploy LabVIEW code the Arduino.

ARDUINO FIRMWARE:

After installing LIFA the Arduino firmware can be found in <LabVIEW>\vi.lib\LabVIEW Interface for Arduino\Firmware\LIFA_Base\LIFA_Base.ino. The firmware consists of two main functions:

syncLV( ) is called in the setup function and establishes the connection between the Arduino and

LabVIEW. This function should only be called once when the Arduino boots

Check For Command( ) is called repeatedly inside the main loop of the Arduino sketch. This command checks the Arduino serial buffer for data from LabVIEW. If a full packet is available this command will process the packet and send the appropriate response to LabVIEW

Check For Command( ) is implemented in LabVIEWInterface.ino and simply checks to see if a full packet (15 bytes by default) is available in the Arduino serial buffer. If a full packet exists in the buffer check For Command( ) calls

The process Command( ) function reads the packet from the Arduino serial buffer, checks to make sure all data was received correctly, and then processes the packet based on the CMD byte (second byte of the packet) using a large case structure. Each case corresponds to a command from LabVIEW and executes the appropriate Arduino functions before returning the expected value(s) to LabVIEW.

STEPS FOR INSTALLATION:

- Firstly install VI Package Manager
- Here for installation Internet should be available throughout the installation process
- After installing VI Package Manager, there it searches various options
- Then we get a option of Lab view interface for Arduino, Now we have to install it
- After installation we get the Icon of Labview beside Arduino interface for Arduino
- Now, we have to open Labview 2012,We get the option of Arduino by Right click on • Front panel of Labview2012
- Then We have to open Lab view2012 and connect the Required circuit using Adriano in
- Labview2012 with proper input output(Read/write)

BLOCK DIAGRAM

Block diagram of water tank depth sensor

EXPLANATION:

1. LabVIEW is a software installed in a PC or LAPTOP with Arduino interface.
2. Pump is fixed in sump filled with water, a float is attached to the overhead tank.
3. The float senses the water level and gives reference voltage to Arduino.
4. This reference voltage is the water level of the tank.
5. This signal is fed to the Labview as a input, there the signal is compared with minimum and maximum levels.

6. The output of Labview is fed to the digital write of Arduino as a input signal.

7. The output of digital write is given as a signal to the base of transistor.

8. The transistor controls the relay based on the signal, the relay turns ON and OFF the motor based on the level of water.

9. The pump turns ON when the water level is low and turns OFF when the water level reaches to a maximum level.

10. Again the pump turns ON when the water level reaches to a minimum level.

LABVIEW Program:

LABVIEW Program

RESULTS:

16.MEASUREMENT OF TEMPERATURE,PRESSURE,HUMIDITY AND WIND SPEED

Aim: To measure the Temperature,Pressure,Humidity and wind speed

Apparatus:

i) Arduino UNO ii)Temperature sensor iii)Pressure sensor iv)Humidity sensor

v)wind speed sensor

Sensors :

HUMIDITY SENSING – CLASSIFICATION & PRINCIPLES

According to the measurement units, humidity sensors are divided into two types: Relative humidity (RH) sensors and absolute humidity (moisture) sensors. Most humidity sensors are relative humidity sensors and use different sensing principles.

Sensors based on capacitive effect

Humidity sensors relying on this principle consists of a hygroscopic dielectric material sandwiched between a pair of electrodes forming a small capacitor. Most capacitive sensors use a plastic or polymer as the dielectric material, with a typical dielectric constant ranging from 2 to 15. In absence of moisture, the dielectric constant of the hygroscopic dielectric material and the sensor geometry determine the value of capacitance. At normal room temperature, the dielectric constant of water vapor has a value of about 80, a value much larger than the constant of the sensor dielectric material

Sensors based on Resistive effect

Resistive type humidity sensors pick up changes in the resistance value of the sensor element in response to the change in the humidity

TEMPERATURE

Measurement of temperature

The most commonly used type of sensors are those which detect Temperature or heat. These types of temperature sensors vary from simple ON/OFF thermostatic devices which 22

control a domestic hot water system to highly sensitive semiconductor types that can control complex process control plants.

.There are different types of Temperature Sensors available and all have different characteristics depending upon their actual application

Types of temperature sensors

Thermistor

The Thermistor is another type of temperature sensor, whose name is a combination of the words THERM-ally sensitive res-ISTOR. A thermistor is a type of resistor which changes its physical resistance with changes in temperature.

Thermocouple

The Thermocouple is by far the most commonly used type of all the temperature sensing devices due to its simplicity, ease of use and their speed of response to changes in temperature.Thermocouples also have the widest temperature range of all the temperature sensors from below -200oC to well over 2000oC. Thermocouples are thermoelectric sensors that basically consist of two junctions of dissimilar metals, such as copper and constantan that are welded or crimped together. One junction is kept at a constant temperature called the reference (Cold) junction, while the other the measuring (Hot) junction. When the two junctions are at different temperatures, a voltage is developed across the junction which is used to measure the temperature

The LM35

LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in oC). You can measure temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

It gives an output voltage proportional to the Celsius temperature. The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 oC at room temperature and +/- oC over a range of 0oC to +100 oC. The scale factor is 01V/oC. The general equation used to convert output voltage to temperature is:

- Temperature (oC) = Vout * (100 oC/V)
- So if Vout is 1V , then, Temperature = 100 oC

Pressure sensors

MP3V5050:

The MP3V5050 series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This patented, single element transducer combines advanced micromachining techniques, thin-film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

mainly to their small size. Thermocouples also have the widest temperature range of all the temperature sensors from below -200oC to well over 2000oC.

Thermocouples are thermoelectric sensors that basically consist of two junctions of dissimilar metals, such as copper and constantan that are welded or crimped together. One junction is kept at a constant temperature called the reference (Cold) junction, while the other the measuring (Hot) junction. When the two junctions are at different temperatures, a voltage is developed across the junction which is used to measure the temperature.

Measurement of Speed:

Wind speed, or wind velocity, is a fundamental atmospheric rate. Wind speed affects weather forecasting, aircraft and maritime operations, construction projects, growth and metabolism rate of many plant species, and countless other implications. Wind speed is commonly measured with an anemometer

Anemometer(wind speed measurement device)

An anemometer is a device for measuring wind speed, and is a common weather station instrument. The term is derived from the Greek word anemos, meaning wind, and is used to describe any airspeed measurement instrument used in meteorology or aerodynamics.

Anemometer is implemented using Proximity sensor,it is able to detect the presense of nearby objects without any physical contact.

Interfacing ARDUINO with MEGUNOLINK

MEGUNOLINK

MegunoLink is a free tool talking to Arduino microcontrollers.Megunolink will upload the

programs you create with tools like AVR studio.But whether you work with the Arduino development environment or another,Megunolink can graph data sent from the Arduino to PC,log serial data to a text file or a monitor window,and can simulate serial protocols for missing devices.

MEGUNOLINK benefits:

- A simple graphical interface to the standard Arduino programmer “AVRDude” for uploading compiled code.we use the same board descriptions as the Arduino IDE to ease the transition.
- A serial port monitor that does not automatically reset Arduino when connecting.you can connect and disconnect while your program continues uninterrupted.
- A window to graph data sent from the Arduino in real time.
- Capture serial port data in a text file for later analysis or tracking down bugs that only occur at 3am

- A floating toolbar:minimize Megunolink while using Atmel studio but keep the programming tool available.

- A button to reset the Arduino on the toolbar to restart your program and monitor its startup communications.

Interfacing with PLX-DAQ

PLX-DAQ Basic principles:

- General: Data, in specific formats,is sent from the controller to the computer's serial port.A visual basic for applications (VBA) macro containing a serial port control is used in Excel to accept data from the serial port,analyze it,place the data in the spreadsheet or perform other actions.Directives are used to inform PLX-DAQ of what action is to be taken.

- Directives:PLX-DAQ analyzes incoming data strings from the basic stamp for action.strings begin with a directive informing PLX-DAQ of what action to take.Most all controllers have a means to send serial data to the PC.The data sent must be formatted properly to be understood by PLX-DAQ.

- All directives are in CAPITAL letters,and some are followed by comma-separated data.Each string must end in a carriage return(CR).

- Strings not beginning with directives will be ignored.

- Strings containg ASCII characters<10 or >200 will not be processed and indicated as an error.

- Plotting or Metering : Beyond collecting data,PLX-DAQ may be used for real time plotting or metering.using the data directive ,data may be plotted using graphing features

of Excel as data fills rows.Though the used of the CELL,SET directives,code may directly update cells allowing real time metering using graphs in Excel.

- Serial communications: The computer serial COM ports are used to communicate with the controller.PLX-DAQ supports Baud rates upto 128000.If you are using a USB device for communications,many of these devices create a Virtual COM port which may be accessed as regular COM port.Your programming software may tell you the port it is programming through,or you can use device manager of windows to view the available ports.Only COM port 1-15 are supported by this software.

- Plotting Example: This example uses the simple test source code and the simple data with plots worksheet.Example code for the BS2,SX,and propeller are provided in a separate download available on parallax's PLX-DAQ page.

The code performs the following:

- Uses the data directive to record data of time(TIME),time since reset(TIMER),and 2 values of a count and SIN of that count value.
- Monitors using ROW,GET when the row has exceeded 300.
- Resets the ROW back to 2 using ROW,SET.
- Graphs the data using graphing features of Excel.

Program in Arduino:

```
#include <GraphSeries.h>

GraphSeries g_aGraphs[] = {"temp","pres","spe","hum"}; void setup()

{

Serial.begin(9600); int pin1=7; pinMode(A2,INPUT); pinMode(A1,INPUT); pinMode(A4,INPUT);

pinMode(pin1,INPUT);

}

void loop()

{ int pin;

for (pin = 0; pin <= 3; pin++)

g_aGraphs[pin].SendData(output1(pin));

}

float output1(int pin)

{ if(pin==0)

{

int val1=analogRead(A2); float vol1=(val1*5)/1023; temp=(vol1)*100; return temp;

}

if(pin==1) {

float val=analogRead(A1); float vol=(val*5)/1023; float m=vol-0.04; float pre=m/0.018; return pre; }

else if(pin==2)
```

```
{
int val3=analogRead(A4); int vol3=val3*(5.0/1023.0); int spe=vol3*0.9716; return spe; }
else if(pin==3)
{ int pin1=7;
#define SAMPLES 4096
long freq = 0;
for(unsigned int j=0; j<SAMPLES; j++) freq+= 660000/pulseIn(pin1, HIGH, 250000);
float sensorValue= freq / SAMPLES;

((9740-sensorValue)/18);
return rh; }
}
```

Graph

RESULTS:

17.MEASUREMENT OF POWER USING ARDUINO

Aim:To measure Electric power consumed in a Single phase AC load Apparatus:

i)Arduino ii)PC iii)Offset current conditioning card

iv)Offset voltage conditioning card v)C.T & P.T vi)Load Power :

Power is rate of expending energy. The unit of power is Watt (joule per second (J/s)). For DC circuits and purely resistive AC circuits, power is product of voltage and current. For reactive AC circuits the product of r.m.s values of voltage and current is termed as apparent power (VA).

Instantaneous Power:The instantaneous power is the product of instantaneous voltage and current.

a) Power measurement using Multisim: In Multisim power can be measured using various methods like 1-wattmeter method, 2-wattmeter method, 3-wattmeter method.

Two wattmeter method: In this method power is measured for three phase balanced loads using two wattmeters. The total power consumed is calculated using the below formula.

Total Power Consumed, Wtotal= √3*(W1+ W2)

Where, W1 – first wattmeter reading & W2 – second wattmeter reading

Let us consider a three phase circuit having resistive balanced loads. Connect the circuit in multisim and the total power calculated is 900watts using the above formula

Simulation circuit of 2-wattmeter method power measurement in multisim

Block diagram of Arduino Power Measurement

Description

The block diagram of the project Power Measurement using Arduino is as shown. The load circuit consists of resistive loads which are bulbs each of rating 200watts. These loads are energized by

single phase 230v DC AC supply. The current and voltage through the load are stepped down to safer values by using a current transformer and potential transformer respectively. As the AC signals can't be given to Arduino board, these signals are offsetted using voltage and current offset data conditioning cards. These cards are energized using regulated DC supply. The function of offset data conditioning cards is to clamp the AC signal with respect to a preset reference DC voltage. The output waves from the voltage offset card are given as analog input to Arduino board at pins A0 and ground. Similarly the output from the current offset card is given as analog input to Arduino board at the pins A2 and ground. Once the analog inputs are given to Arduino, the microcontroller on the board is programmed for the measurement of power in Arduino sketch.

Block diagram of Arduino Power Measurement

Offset data conditioning card:

Simulation circuit of offset data conditioning card in multisim

Description

The circuit diagram of the offset data conditioning card is as shown. It consists of two op-amps, UA714CN which are operated in inverting mode. The first op-amp is used as a summing amplifier. It adds up the input signal with the DC reference voltage. The output of the first op- amp is inverted using the second op-amp which acts as an inverting amplifier. The output of this op-amp is taken out as the output of the offset data conditioning card.

Regulated DC supply

From this AC voltage all the harmonics are removed by using diodes and the output voltage is further converted to constant DC voltage by using regulators 7812 and 7912. From this voltage the distortions are removed by using capacitive filters. This circuit finally outputs a voltage of +12, 0, -12V.

Load circuit

The load circuit consists of resistive loads which are bulbs as shown in the figure. These loads are each of wattage 200watts. The maximum load being used is 600watts.The current and voltage values of load are stepped down by using current transformer and potential transformer respectively.

Load circuit

Arduino program for measuring power and displaying graphically using MegunoLink

```
#include <GraphSeries.h>            // Including the header file
GraphSeries g_aGraphs[] = {"power(Watts)"};     // Plotting graph for power in Watts
float Voltage = A0;         //Defining and initializing the voltage
float Current = A2;
```

```
float I = 0; float V = 0; float P = 0; float P1 = 0; void setup( )

{

Serial.begin(9600);        // Defining and initializing the current

pinMode(Voltage,INPUT); //Set voltage as input pin pinMode(Current,INPUT); //Set current as input pin

pinMode(P1,OUTPUT);                    //Set power as output pin

}

void loop( )

{

float realPower = 0;

            for(int i=0;i<400;i++)      // Using for loop to calculate average power

{

float P = 0;

V= ((analogRead(Voltage)-(2.3*204.6))/204.6)*(66.474*1.414);

//Voltage from A0 is negative offsetted to get AC waveform and is then multiplied with transformation
ratio of PT to get actual voltage waveform

I= ((analogRead(Current)-(2.22*204.6))/(204.6*20))*(76.667*1.414);

//Current from A2 is negative offsetted to get AC voltage waveform, which is then converted to current
by dividing voltage with appropriate resistance to get AC current waveform and is then multiplied with
transformation ratio of CT to get actual current waveform

P=V*I;   // Voltage and current waves are multiplied at some instants

realPower=realPower+abs(P); delay(0.05);

}            //Power is added after successive instants

P1=realPower/400.0;     // Above obtained power is averaged by number of instants

Serial.println(P1);

            //Moving the value of average power to com window

g_aGraphs[0].SendData(P1);      // Displayed average power using MegunoLink

}
```

Program to display the average power in Processing software:

```
        import processing.serial.*;        //Importing data from Arduino to processing software

Serial port;

int xPos=1;      //Defining a variable for position of x int dely=10;          // Defining a variable for
position of y void setup()

{

        size(1280,768);  // Declaring the size of display screen

port = new Serial(this, "COM5", 9600);   // Set the com port same as that of Arduino
port.bufferUntil('\n');    // Repeat the data until new line character is encountered

}

        void draw( )      // used for 3D geometry

{ }

void serialEvent (Serial port)

{

String inString = port.readStringUntil('\n'); character is encountered      // Reading the data from strings
until new line

if (inString != null)        // Checking if string is empty

{

inString = trim(inString); // This function removes the spaces from the beginning and end of string
including tab spaces

        float inByte = float(inString);      // Storing the new string as float

inByte = map(inByte, 0, 1023, 0, height);          // This function remaps the numbers in the string from
one range to another

line(xPos,height,xPos,height - dely);      // Line function with 4 parameters used to display 2D line

        stroke(inByte,0,255);    // Used for colouring of line

        noFill();          // Disables the filling of geometry

line(xPos, height- inByte, xPos, height);

if (xPos >= width {        // Check for the position of x and width of screen

xPos = 0;         // If xpos is greater than width of screen reinitialize it to zero position

background(0);  // Colouring of the background
```

```
} else {
xPos++; // If xpos is not greater than width of screen then incrementing its value
}
}
}
```

Simulation results

Three Loads :

Serial monitor values for three loads in Arduino

Megunolink plotting for three loads

Varying Loads :

If the loads are increased and decreased in a step wise manner then the graphs obtained in Megunolink and Processing software's will be as follows respectively

Megunolink Plotting for varying loads

Results:

18.MEASUREMENT OF ENERGY USING ARDUINO

Aim:To measure Electric Energy in a Single phase AC load

Apparatus:

i)Arduino ii)PC iii)Offset current conditioning card

iv)Offset voltage conditioning card v)C.T & P.T vi)Load

ENERGY: The amount of energy used (or supplied) depends on the power and the time for which it is used.Energy makes change; it does things for us. It moves cars along the road and boats over the water. It bakes a cake in the oven and keeps ice frozen in the freezer. It plays our favorite songs on the radio and lights our homes. Energy makes our bodies grow and allows our minds to think. Scientists define energy as the ability to do work.

Offset circuit output

SIMULATION RESULTS

FOR SINGLE LOAD

Graph for power output in meguno link

Graph for energy output in megunolink

FOR TWO LOADS

power output in meguno link

Energy graph in meguno link

FOR THREE LOADS

Power output in meguno link

Energy output in meguno link

Experiment:Student should modify the power measurement program to obtain Energy measurement with the same set up and obtain the above curves.

Results:

19.POWER FACTOR MEASUREMENT

Aim: To measure the power factor of an RLC circuit.

Apparatus:

Software: LAB View Software Hardware: DAQ 1 No

Transformers (230v/3v) 2 No

Resistor (100ohms) 1 No

Lamps 3No

Chokes 4No

Capacitors 3No

Theory:

The power factor of an a.c circuit can be calculated using the relationship Cos θ = P/VI.

One method of measuring power factor is by using power factor meters.

Power factor meters have deflection force and controlling force only.

There are two types of power factor meters.

(a) Electro dynamo meter type (b) Moving Iron type

These meters posses a current coil circuit and a pressure coil circuit. The pressure coil circuit connected across the supply lines is split up into two parallel paths. One inductive and the other is resistive. The deflection of the instrument depends upon the phase difference between the main current and currents in the two coils.

The accuracy obtained with the use of power factor meters is sufficient for most of the purposes, other than the precision testing.

The power factor meter may become inaccurate during the period of its use due to several reasons. Hence, it is to be calibrated, periodically.

The another way of measuring power factor is by using LabView software wherein block diagram programming is done & powerfactor can be measured.

The power factor can be calculated from taking the phase of the voltage waveform and phase of the current waveform and difference of those phase angles of the waveforms gives the net phase angle of the circuit. Cosine of the difference of the phase angles gives the power factor.

Procedure:-

1. Connect the circuit as per the circuit diagram.
2. Interface & configure the required analog inputs to the DAQ. 3. Switch on the load like

i) lamp ii) lamp + choke etc.

4. Note the readings of phase of voltage & phase of current.
5. Note the reading of power factor.

Circuit Diagram:

Observation:

Sample Calculations:-

$\Phi v - \Phi i = \Phi$

Φv = Phase of voltage Φi = Phase of current

Φ = Phase difference

Power factor= $\cos\Phi$

LabView Program:

Front Panel LabView:

Result:

20. SINGLE PHASE ENERGY METER USING LABVIEW

AIM: To calibrate energy meter using Lab view.

APPARATUS:

Name of equipment	Quantity in number
Current Transformer (CT)	1
Potential Transformer (PT)	1

Sigle phase RLC load 1

Data Acquisition Card (DAQ) 1

Personal Computer (PC) or Laptop 1

Interface cable 1

Description of the power circuit:

This circuit consists of a lamp load,an inductive load and a capacitive load,each controlled by its individual switch.The current drawn by the load is reduced to a small value by the current transformer.since LABVIEW data acquisition card can not sense current directly,the current signal is converted to voltage by means of a resistor.A.C voltage applied to the load is alos reduced to small value by means of a potential transformer.After further reducing it by means of a potential divider,this voltage is applied to the Data Acqisition card.

Description of the functioning of LABVIEW program:

The voltage and current values extracted by the data acquisition card are multiplied by the suitable values so that actual voltage and current values obtained.A Labview block obtains the RMS values of the voltage and current.Tone measurement block obtains the phase angle of voltage and current waveforms separately.Difference between these two values is the phase angle between voltage and current which is obtained in degrees.This value is converted into radians and applied to the cosine block,the output of this block is the power factor.Now the following formula is implemented for the Labview.

$P=V_{RMS} * I_{RMS}*\cos\Phi$

Excercise 1:Find the reactive power with slight modification of the above program.

Excercise 2:Find the apparent power with slight modification of the above program.

Excercise 3:Find real,reactive and apparent powers using any program other than the above.

Power circuit for determining the active,reactive and apparent power & powerfactor:

LABVIEW PROGRAM:

Front Panel in LABVIEW:

Result:

21. CALIBRATION OF THREE PHASE ENERGY METER USING LABVIEW

AIM: To calibrate energy meter using Lab view.

APPARATUS:

Name of equipment	Quantity IN NUMBER
Current Transformer (CT)	3
Potential Transformer (PT)	3
Energy meter 3ph 4-wire	1
Three phase RLC load	1
Data Acquisition Card (DAQ)	1
Personal Computer (PC) or Laptop	1
Interface cable	1

THEORY:

The calibration of energy meter becomes inaccurate during its rigorous use due to various reasons. It is necessary to calibrate the meter to determine the error, so that same meter can be used for correct measurement of energy.

The driving system of the meter consists of current coil connected in series with load and shunt coil connected in parallel to the supply. The moving system consists of a nonmagnetic

material and light material i.e aluminum disc. This disc is positioned in the air gap between series and shunt magnets. A permanent magnet is positioned near the edge of the aluminum disc, which forms the braking system. At steady speed of the disc, the driving torque is equal to the braking torque.

For 1200 rev. the meter reads 1 KWh

So, for x revolutions the meter reads x/1200 KWh

PROCEDURE:

1. Connect the circuit as shown in figure.

2. Make sure CT's primaries are connected in series to supply and CT's secondaries are connected to DAQ analog inputs. Also PT's primaries in parallel to supply and secondaries are connected to DAQ analog inputs.

3. Interface DAQ output to PC by using USB cable.

4. Run labview program shown in figure .

5. For various loads note down the readings of energy meter and labview program output.

6. Calibrate energy meter and labview program readings

OBSERVATION:

CIRCUIT-DIAGRAM:

LabView Program

Front Panel In LabView

Result: