INSTITUTE OF AERONAUTICAL ENGINEERING
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Lab Manual:

ELECTRIAL MEASURMENTS AND INSTRUMENTATION LABORATORY(AEEB25)

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Contents

INTRODUCTION

Introduction

This course is intended to enhance the learning experience of the student in topics encountered in Engineering Physics Course AHSC03.In this lab, students are expected to develop the practical skills required to do the experiments and gain experience in using the basic measuring devices used in Computer Science Engineering. Students also learn to interpret the experimental results in terms of the concepts introduced in the Engineering Physics course.How the student performs in the lab depends on his/her preparation and participation. Each student must participate in all aspectsof the lab to ensure a thorough understanding of the equipment and concepts. The student, Faculty teachingthe lab course, Laboratory In-charge and faculty coordinator all have certain responsibilities towards successful completion of the lab's goals and objectives.

Student Responsibilities

The student is expected tocome prepared for each lab.Lab preparation includes understanding the labexperiment from the lab manual and reading the related textbook material.

Students have to write the allotted experiment for that particular week in the work sheets given and carry them to the Lab. In case of any questions or problems with the preparation, students can contact the Faculty Teaching the Lab course, but in a timely manner.

Students have to be in formal dress code, wear shoes and lab coat for the Laboratory Class.

After the demonstration of experiment by the faculty, student has to perform the experiment individually. They have to note down the observations in the observation Tables drawn in work sheets, do the calculations and analyze the results.

Active participation by each student in lab activities is expected. The student is expected to ask the Faculty any questions they may have related to the experiment.

The student should remain alert and use commonsense while performing the lab experiment.They are also responsible for keeping a professional and accurate record of the labexperiments in the files provided.

Responsibilities of Faculty Teaching the Lab Course

The Faculty shall be completely familiar with each labprior to the laboratory. He/She shall provide the students with details regarding the syllabus and safety review during the first week.Lab experiments should be checked in advance to make sure that everything is in working order.The Faculty should demonstrate and explain the experiment and answer any questions posed by the students.Faculty have to supervise the students while they perform the lab experiments. The Faculty is expected to evaluate the lab worksheets and grade them based on their practical skills and understanding of the experiment by taking Viva Voce. Evaluation of work sheets has to be done in a fair and timely manner to enable the students, for uploading them online through their CMS login within the stipulated time.

Laboratory In-charge Responsibilities

The Laboratory In-charge should ensure that the laboratory is properly equipped, i.e., the Faculty teaching the lab receive any equipment/components necessary to perform the experiments.He/She is responsible for ensuring that all the necessary equipment for the lab is available and in working condition. The Laboratory In-charge is responsible for resolving any problems that are identified by the teaching Faculty or the students.

Course Coordinator Responsibilities

The course coordinator is responsible fo rmaking any necessary corrections in Course Description and lab manual. He/She has to ensure that it is continually updated and available to the students in the CMS learning Portal.

Lab Policy and Grading

The student should understand the following policy:

ATTENDANCE: Attendance is mandatory as per the academic regulations.

LAB RECORD's: The student must:

1. Write the work sheets for the allotted experiment and keep them ready before the beginning of eachlab.
2. Keep all work in preparation of and obtained during lab.
3. Perform the experiment and record the observations in the worksheets.
4. Analyze the resultsand get the work sheets evaluated by the Faculty.
5. Upload the evaluated reports online from CMS LOGIN within the stipulated time.

Grading Policy:

The final grade of this course is awarded using the criterion detailed in the academic regulations. A large portion of the student's grade is determined in the comprehensive final exam of the Laboratory course (SEE PRACTICALS),resulting in a requirement of understanding the concepts and procedure of each lab experiment for successful completion of the lab course.

Pre-Requistes and Co-Requisties:

The lab course is to be taken during the samesemester as AHSC03, but receives a separate grade. Students are required to have completed both AHSC03 and AHSC05 with minimum passing grade or better grade in each.

Course Goals and Objectives

The Physics Laboratory course is designed as a foundation course to provide the student with the knowledge to understand the basic concepts in Physics which have lot of applications in the field of Engineering.

The experiments are designed to complement the concepts introduced in AHSC03. In addition, the student should learn how to record experimental results effectively and present these results in a written report.

More explicitly, the class objectives are:

1. To gain proficiency in the use of common measuring instruments.
2. To enhance understanding of theoretical concepts including:
   - Carrier concentration in semiconducting materials
   - Waves in one Dimension
   - Magnetic Induction
   - Hysteresis losses.
   - Energy Gap in a semiconductor.
   - Photo Diode and its working Principle
   - Numerical Aperture and Acceptance angle of an Optical Fiber.
   - Diffraction due to N Slits
   - Planck's constant
   - Light Emitting Diode and its Working Principle
   - Interference in thin Films
   - Diffraction due to Single slit
3. To develop communication skills through:
   - Verbal interchanges with the Faculty and other students.
   - Preparation of succinct but complete laboratory reports.
   - Maintenance of laboratory worksheets aspermanent, written descriptions of procedures, analysis and results.
4. To compare theoretical predictions with experimental results and to determine the source of any apparent errors.

Use of Laboratory Instruments

One of the major goals of this lab is to familiarize the student with the proper equipment andtechniques for conducting experiments. Some understanding of the lab instruments is necessaryto avoid personal or equipment damage.By understanding the device's purpose and following a fewsimple rules, costly mistakes can be avoided.

The following rules provide a guideline for instrument protection.

Instrument Protection Rules

Data Recording and Reports

The Laboratory Worksheets

The Laboratory Files/Reports

LAB-1 ORIENTATION

1.1 Introduction

In the first experiment period, the students should become familiar with the location of equipment and components in the lab, the course requirements, and the teaching instructor.

1.2 Objective

To familiarize the students with the lab facilities, equipment, standard operating procedures, lab safety, and the course requirements.

1.3 Prelab Preparation:

Read the introduction and procedure of the experiment of respective experiments which are given this manual.

1.4 Equipment needed

Lab manual

1.5 Procedure

1. During the first laboratory period, the faculty coordinator will provide the students with a general idea of what is expected from them in this course. Each student will receive a copy of the syllabus, stating the faculty coordinator's contact information. In addition, the faculty coordinator will review the safety concepts of the course.

2. During this period, the faculty coordinator will briefly review the equipment which will be used throughout the semester. The location of instruments, equipment, and components will be indicated. The guidelines for instrument use will be reviewed.

1.6 Further Probing Experiments

Questions pertaining to this lab must be answered at the end of laboratory report.

LAB-2 SENSING OF TEMPERATURE AND SPEED

(A) SENSING OF TEMPERATURE

2.1 Introduction

A thermistor is a piece of semiconductor made from metal oxides, pressed into a small bead, disk, wafer, or other shape, sintered at high temperatures, and finally coated with epoxy or glass. The resulting device exhibits an electrical resistance that varies with temperature.There are two types of thermistors – negative temperature coefficient (NTC) thermistors, whose resistance decreases with increasing temperature, and positive temperature coefficient (PTC) thermistors, whose resistance increases with increasing temperature. NTC thermistors are much more commonly used than PTC thermistors, especially for temperature measurement applications.

2.2 Objective

Measurement of temperature using transducers like thermocouple, thermistors and resistance temperature detector with signal conditioning.

2.3 Prelab Preparation:

Read the material in the textbook that describes thermocouple, thermistors and resistance temperature detector. Prior to coming to the lab, complete the Procedure.

2.4 Equipment needed

Temperature transducers, digital temperature indicator, Thermometer, Electric sterilizer.

2.5 Circuit Diagram

2.6 Procedure

1. Select the Thermocouple/RTD/Thermister by selector switch.
2. Select the Thermocouple/RTD/Thermister by selector switch.
3. Set the min pot to read the ambient temperature in display.
4. Insert Thermocouple/RTD/Thermister in the hot bath.
5. Digital LED display shows the temperature obtaining at the hot bath directly in degrees Celsius.
6. If necessary adjust the max pot for the maximum level of temperature calibration.

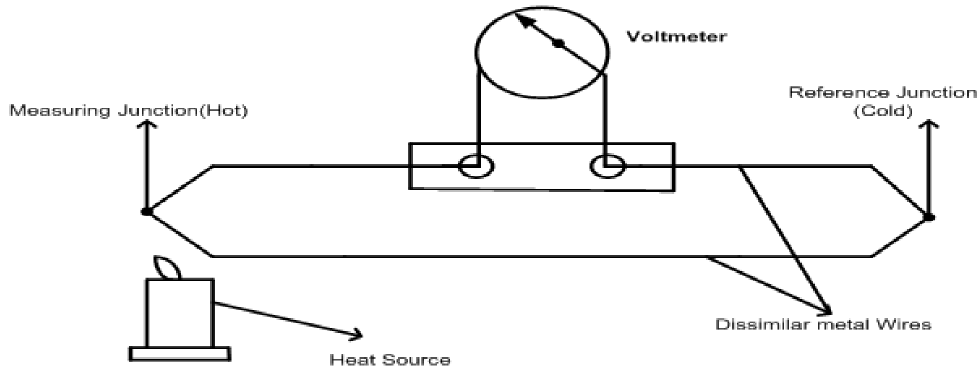


Figure 2.1: Thermocouple.

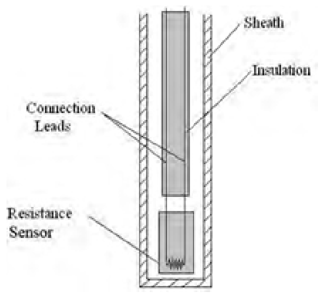


Figure 2.2: RTD.

7. Recorder red and green terminals for the anal output.
8. Fuse holder provider to protect the circuit from the over load (500 mA).

2.7 VIVA Questions

1. What is the working principle of thermocouple?
2. What are the types of thermocouple?
3. What is singular transformation method?
4. What is the cold junction compensation techniques?
5. What is generator bus?
6. What are the advantages of thermistors?

2.8 Further Probing Experiments

(B) SPEED MEASUREMENT USING PROXIMITY SENSOR

2.9 Objective

Speed measurement using proximity sensor.

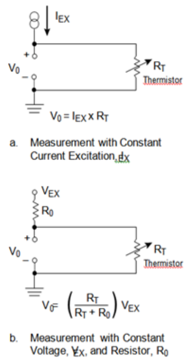


Figure 2.3: Thermister.

2.10 Prelab Preparation:

Read the material in the textbook that describes thermocouple, thermistors and resistance temperature detector. Prior to coming to the lab, complete the Procedure.

2.11 Equipment needed

Digital speed indicator, optical or photo sensor, Proximity or Magnetic sensor.

2.12 Circuit Diagram

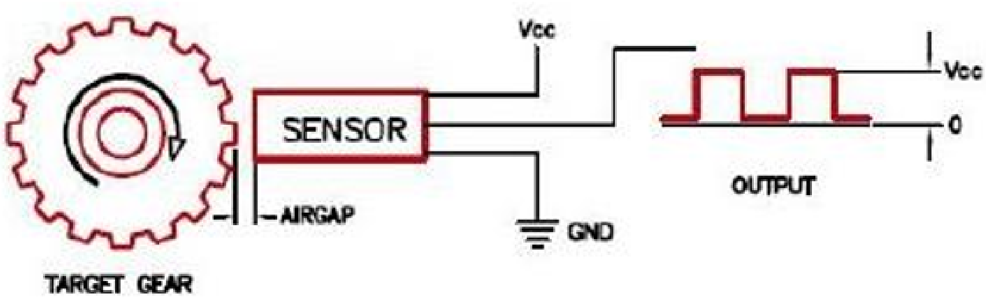


Figure 2.4: Magnetic pickup (Proximity) sensor.

TABULAR COLUMN:

S. No	Tachometer reading	Proximity / Magnetic Sensing Device Reading
1		
2		
3		
4		
5		

2.13 VIVA Questions

1. What is proximity sensor?
2. What is optical sensor?
3. What are the applications of proximity sensor
4. What are the applications of optical sensor

LAB-3 MEASUREMENT OF RESISTANCE USING KELVINS DOUBLE BRIDGE

3.1 Introduction

Kelvins double bridge may be used for precision mesurement of four-terminal low resistances. Four terminal resistors have two current leading terminals and two potential terminals across which the resistance equals the marked nominal value. This is because, the current must enter and leave the resistor in a fashion that there is same or equivalent distribution of current density between the particular equipotent surfaces used to define the resistance. The additional points also eliminated any contact resistance at the current lead-in terminals.

3.2 Objective

To measure very small resistance

3.3 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

3.4 Equipment needed

Kelvins Double Bridge Trainer Kit

3.5 Theory

A Kelvin Bridge is a measuring instrument used to measure unknown electrical resistors below 1 ohm. It is specifically designed to measure resistors that are constructed as four terminal resistors.

3.6 Procedure

1. Connections are made as per the connection diagram
2. Connect the unknown resistance at R terminals.
3. Switch ON the unit.
4. Select the range selection switch at the point where the meter reads least possible value of voltage.
5. Vary the potentiometer (S) to obtain null balance.

6. Switch OFF the unit and find the resistance using multimeter at S.
7. Tabulate the readings and find the value of unknown resistance using the above formula.
8. Repeat the above for different values of unknown resistors

3.7 Circuit Diagram

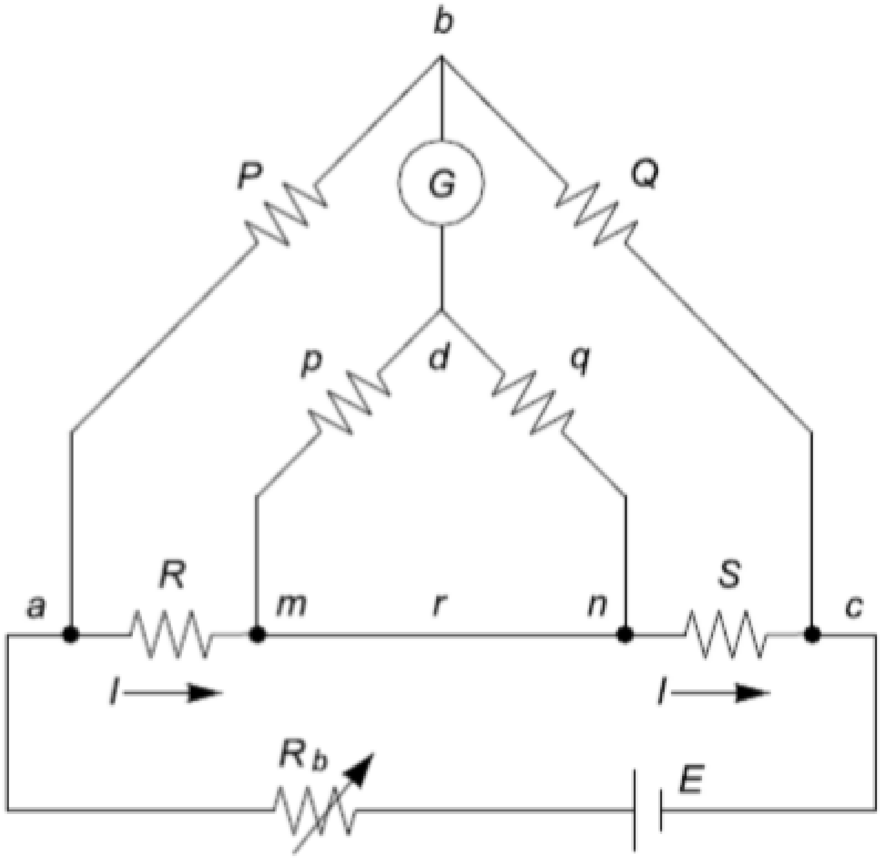


Figure 3.1: Kelvins double bridge.

TABULAR COLUMN:

S. No.	X Main dial Reading	Y Slide dial Reading	Z Multiple range used	R =unknown resistance
1				
2				

S. No.	Observed Value	Calculated Value	% Error
1			
2			
3			

LAB-4 MEASUREMENT OF STRAIN AND PRESSURE

(A) MEASUREMENT OF STRAIN

4.1 Objective

Strain measurement using strain gauge.

4.2 Prelab

Read the material in the textbook that describes differential pressure transducer. Prior to coming to the lab, complete the Procedure.

4.3 Equipment needed

Strain Gauge Trainer Kit, Pressure Sensor

Trainer Kit:

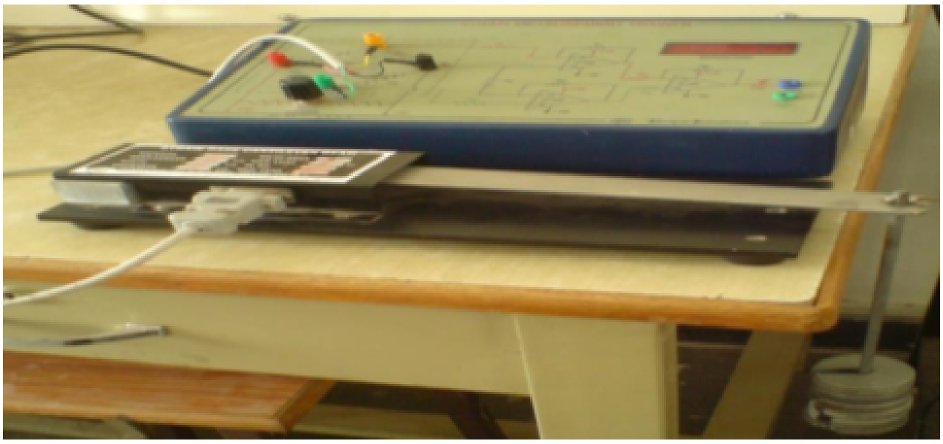


Figure 4.1:

4.4 Circuit Diagram

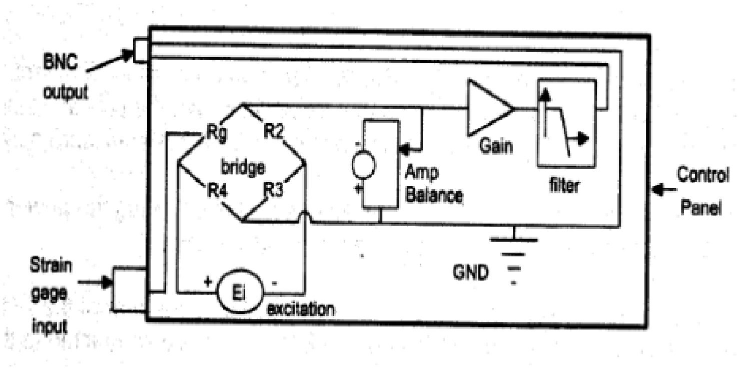


Figure 4.2:

4.5 Procedure

1. Check connection made and Switch ON the instrument by toggle switch at the back of the box. The display glows to indicate the instrument is ON. in ON Position for 10 minutes for initial warm-up.
2. Adjust the ZER
3. Allow the instrumentO 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				

Figure 4.3:

4.6 VIVA QUESTIONS:

1. What is mean by strain?
2. What are methods to measure the strain?

3. What are units for strain?
4. What is meant by stress?
5. What are applications of star in measurement?

(B) MEASUREMENT OF PRESSURE

4.7 Introduction

Pressuremeasurementisimportantinmanyfluidmechanicsrelatedapplications.Fromappropriatepressuremeasureme
.A negative gauge pressure is referred to as vacuum.

4.8 Objective

Measurement of pressure using differential pressure transducer.

4.9 Prelab

Read the material in the textbook that describes differential pressure transducer. Prior to coming to the lab, complete the Procedure.

4.10 Equipment needed

ST2308 Pressure Transducer Trainer, Pressure Vessel, Foot Pump

4.11 Procedure

1. Fill the pressure vessel up to 90 psi (don't cross the range) with the help of footpump, while filling be sure that the outlet valve is closed (Off Position).
2. Connect the outlet (valve with lever) of the Pressure Vessel to any one of the inlet (either P1 or, P2) of the Pressure Transducer with the help of tube provided.
3. Keep the other inlet (P1 or, P2) of the Transducer, so that the other pressure will be the Atmospheric pressure.
4. Connect the circuit as shown in the figure
5. Switch on the power of ST2308 Pressure Transducer Trainer
6. Now, very slowly open the valve in order to release the pressure from the vessel and flow to the transducer's input.
7. Observe the DVM and Pressure Gauge, and note down the readings in observation table.
8. Plot the Graph according to the readings

4.12 Circuit Diagram

4.13 Further Probing Experiments

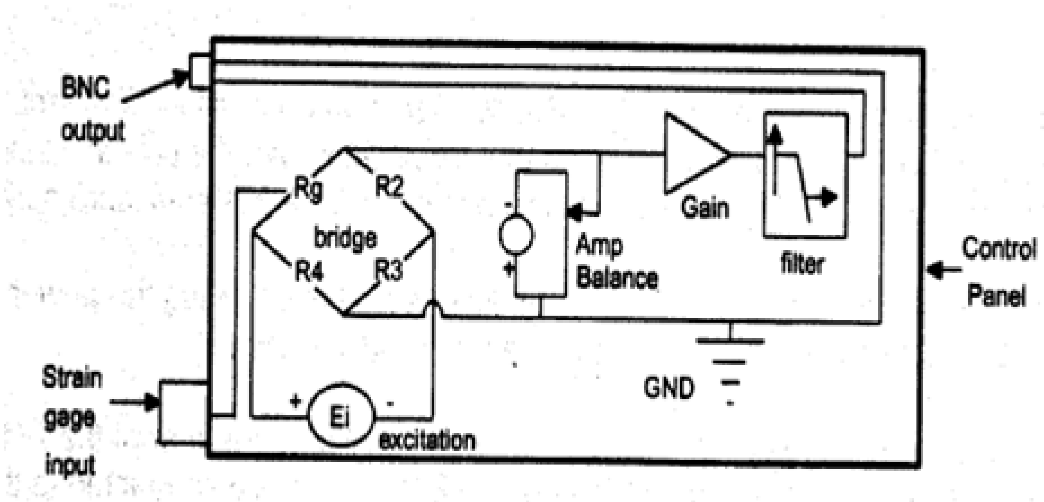


Figure 4.4: Circuit Diagram of Resistance Strain Gauge Strain .

LAB-5 MEASUREMENT OF POSITION AND LEVEL

(A) MEASUREMENT OF POSITION

5.1 Introduction

The most widely used inductive Transformer to translate the linear motion into electrical signals is the Linear Variable Differential Transformer (LVDT). The LVDT acting as primary transducers converts the displacement directly into an electrical output proportional to displacement, i.e. the Mechanical Variable (displacement) is converted into Analog Signal (Voltage) directly LVDT provides continuous reduction and shows the low hysteresis and hence, repeatability is excellent under all condition. As there are no sliding contacts, there is less friction and less noise.

5.2 Objective

To measure the displacement using linear variable differential transformer.

5.3 Prelab Preparation:

Read the material in the textbook that describes linear variable differential transformer. Prior to coming to the lab, complete the Procedure.

5.4 Equipment needed

LVDT Trainer Kit

5.5 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 potentiometer till 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, LVDT trainer kit display and multimeter reading.

5.6 Circuit Diagram

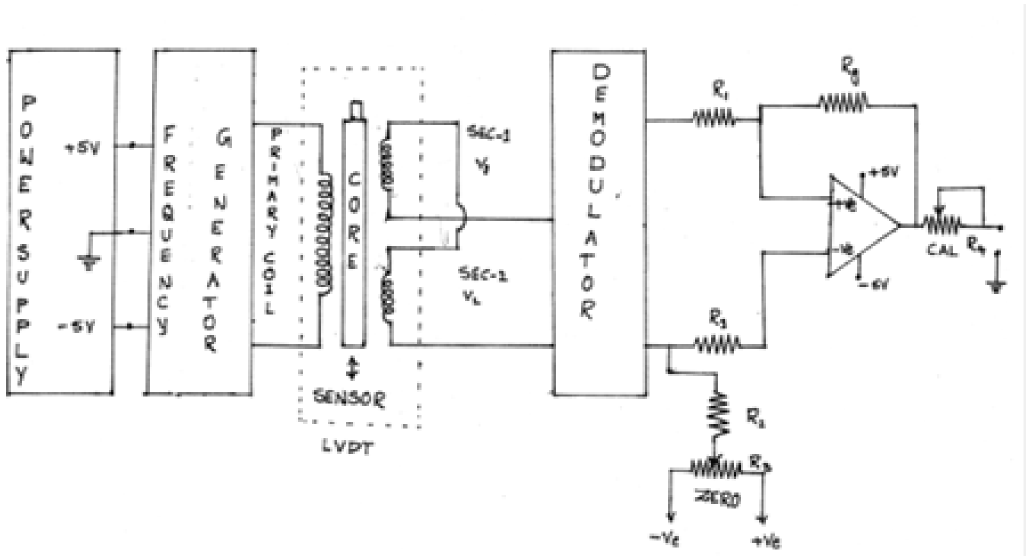


Figure 5.1: Circuit Diagram of LVDT and Capacitance Pickup – Characteristics and Calibration.

(B) MEASUREMENT OF LEVEL

5.7 Objective

Measurement of water level by using capacitor transducer

5.8 Prelab Preparation:

Read the material in the textbook that describes linear variable differential transformer. Prior to coming to the lab, complete the Procedure.

5.9 Equipment needed

Capacitor transducer,Trainer Kit

5.10 Procedure

1. Locate the level measurement system along with the cylindrical tank and sensor on a suitable table fill the sump with water to about 80 percent of full level.

2. Connect the Amped cable to the input of the digital instrument.

3. Fill the water until the water level reaches zero mark on scale. If necessary adjust the zero level Plot 2 (minimum).

4. The DPM should indicate 0.0, for this zero level adjust the plot 2 is required. Now increase the water level up to 30 cm on the tank. Adjust the plot 1 (max) to get on indication of 38 mm. Try to get 300 mm on meter by plot 1 (max).

5. Now we may start from zero level and fill up the tank up to 30 cm and then enter the readings in the table.

6. Before we enter the reading we may have to wait for 2 to 3 minutes before reading stabilizes. The surface tension of the water forms a small layer on the Teflon electrode and reading takes some time to get stabilized until this layer comes down.

5.11 Circuit Diagram

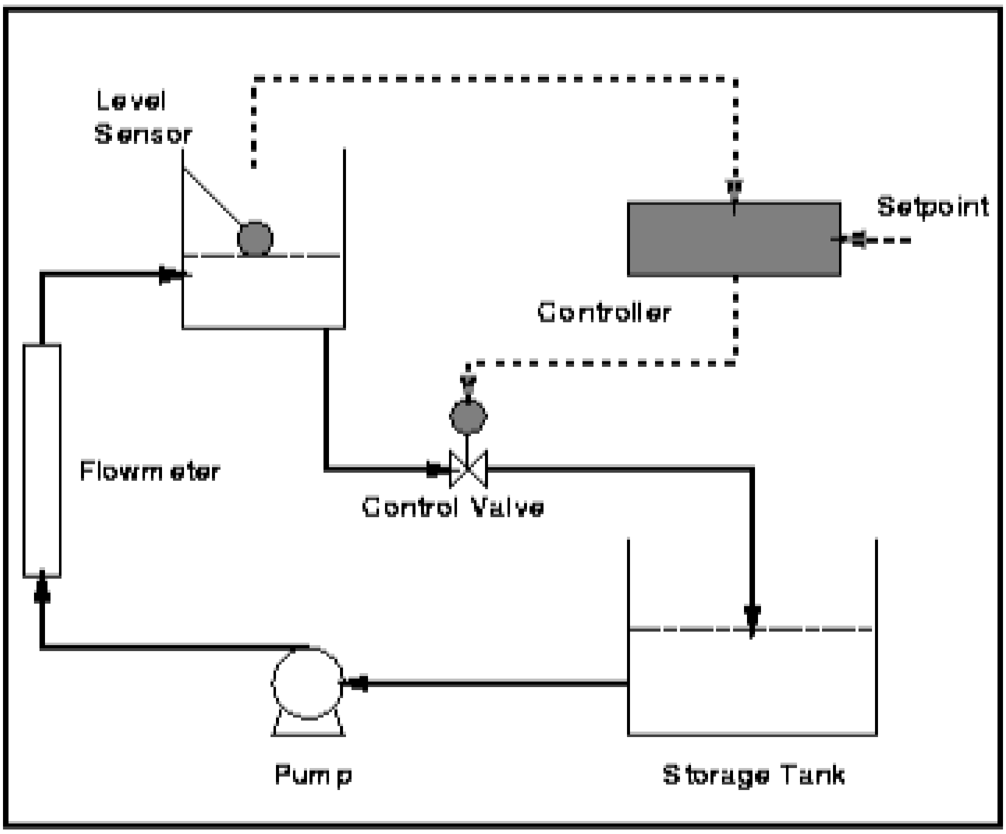


Figure 5.2:

TABULAR COLUMN:

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

Figure 5.3:

LAB-6 PHANTOM LOADING ON LPF WATTMETER

6.1 Introduction

Phantom loading is the phenomena in which the appliances consume electricity even when they turn off. The disc of the energy meter rotates which increases the reading of the meter, but the devices do not consume power. This type of loading is also known as the vampire or virtual loading. The phantom loading mainly occurs in the "electronic" appliances.

6.2 Objective

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

6.3 Prelab Preparation:

Read the material in the textbook that describes LPF wattmeter. Prior to coming to the lab, complete the Procedure

6.4 Equipment needed

Write the text hereAuto Transformer Voltmeter Ammeter LPF Wattmeter Connecting wires

6.5 Procedure

1. Keep the Autotransformer at zero position
2. Make connections as per the Circuit diagram shown below.
3. Switch on the 230 VAC, 50 Hz. power supply.
4. Increase the input voltage gradually by rotating the Autotransformer in clockwise direction.
5. Adjust the load rheostat so that sufficient current flows in the circuit. Please note that the current should be less then potentiometer rating.
6. Note down the Voltmeter, Ammeter, Wattmeter for different voltages as per the tabular column.
7. Find out the percentage error by using above equations.

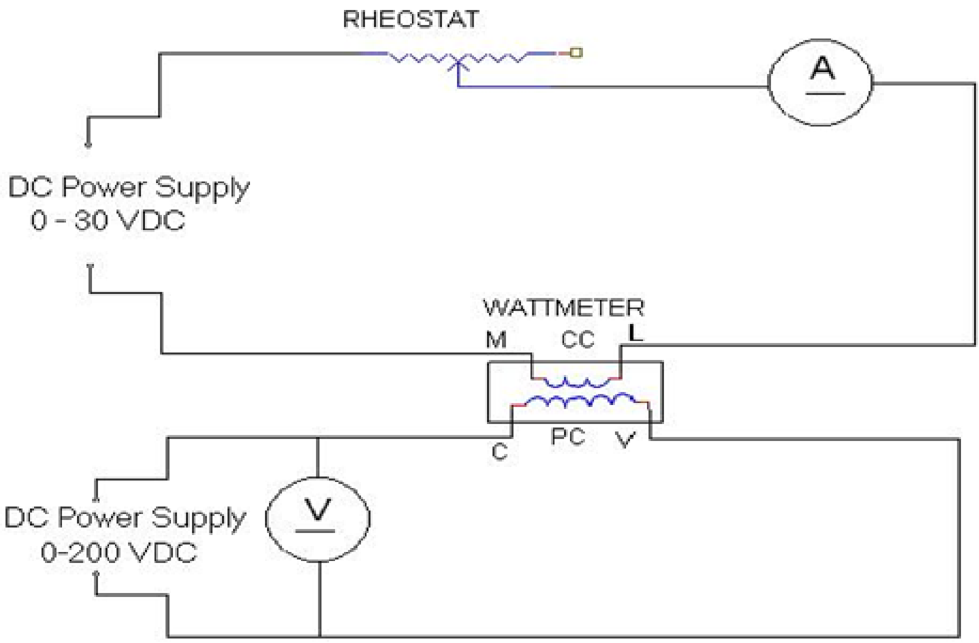


Figure 6.1: Calibration of LPF Wattmeter by Phantom Testing.

6.6 Circuit Diagram

6.7 Further Probing Experiments

LAB-7 CALIBRATION OF SINGLE PHASE ENERGY METER AND POWER FACTOR METER

7.1 Introduction

Determine the error and percentage error at 5 percent, 25 percent and 100 percent of full load current for the given single phase energy meter. .

7.2 Objective

To calibrate and testing of single phase induction type energy meter.

7.3 Prelab Preparation:

Read the material in the textbook that describes single phase induction type energy meter. Prior to coming to the lab, complete the Procedure

7.4 Equipment needed

Write the text hereEnergy Meter,Voltmete, Ammeter, Resistive Load, Stop Watch, 1-Ph Variac, Connecting wires.

7.5 Procedure

1. Connect the circuit as per the circuit diagram.
2. Set Auto Transformer at zero voltage position before switching on the supply.
3. Gradually increase the voltage using the auto-transformer till the voltmeter reads 230V.
4. Now apply the Load at certain value must be less than half of the rated current of energy meter.
5. Note down the time taken for 5 rev. of the disc of the energy meter in the forward direction.
6. Note down the Voltmeter, Ammeter and Wattmeter readings.
7. The experiment is repeated for different values of load current at constant voltage.
8. After noting the values slowly decrease the auto transformer till Voltmeter comes to zero voltage position and switch off the supply.
9. After noting the values slowly decrease the auto transformer till Voltmeter comes to zero voltage position and switch off the supply.

7.6 Circuit Diagram

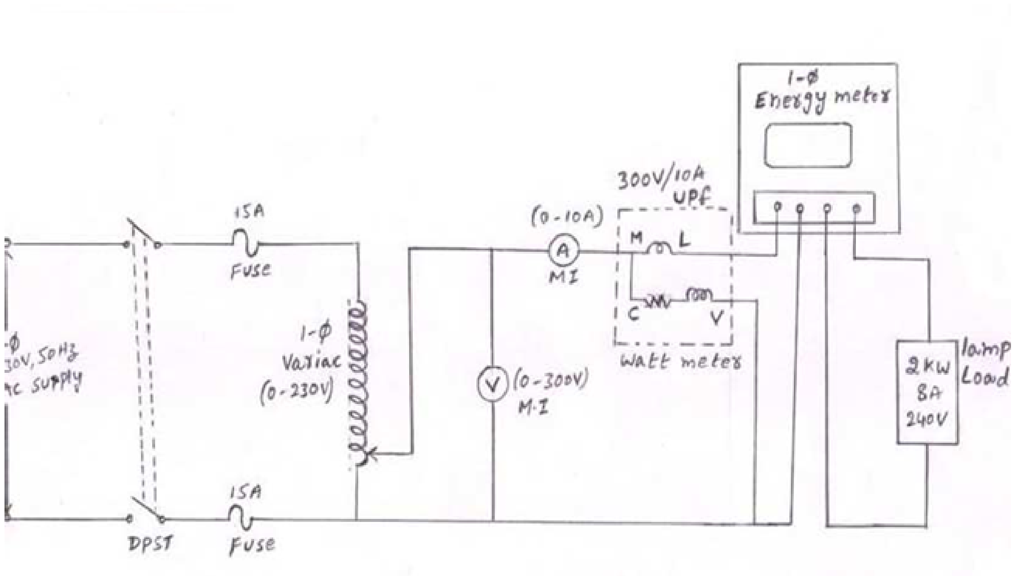


Figure 7.1: Calibrations and Testing of Single Phase Energy Metere.

7.7 Further Probing Experiments

LAB-8 MEASUREMENT OF TURNS RATIO AND APPLICATION OF CTs

8.1 Introduction

The transformer turns ratio is the number of turns of the primary winding divided by the number of turns of the secondary coil. The transformer turns ratio provides the expected operation of the transformer and the corresponding voltage required on the secondary winding.

8.2 Objective

To find the turns ratio of transformer by using A.C bridge.

8.3 Prelab Preparation:

Read the material in the textbook that describes turns ratio of transformer by using A.C bridge. Prior to coming to the lab, complete the Procedure

8.4 Equipment needed

Transformer under test Transformer with adjustable range (standard), Zero position indicator(Digital AC Voltmeter), Applied voltage to the bridge and HV winding (220 V, 50 Hz), Induced voltage at the LV winding

8.5 Procedure

1. Make the connection as per the circuit diagram.
2. Apply the supply to the high voltage side of the transformers.
3. Change the tapping positions of transformer from 0v-14v and note the Ac voltmeter readings simultaneously.
4. Calculate the turns ratio using below formulae.

8.6 Circuit Diagram

8.7 Further Probing Experiments

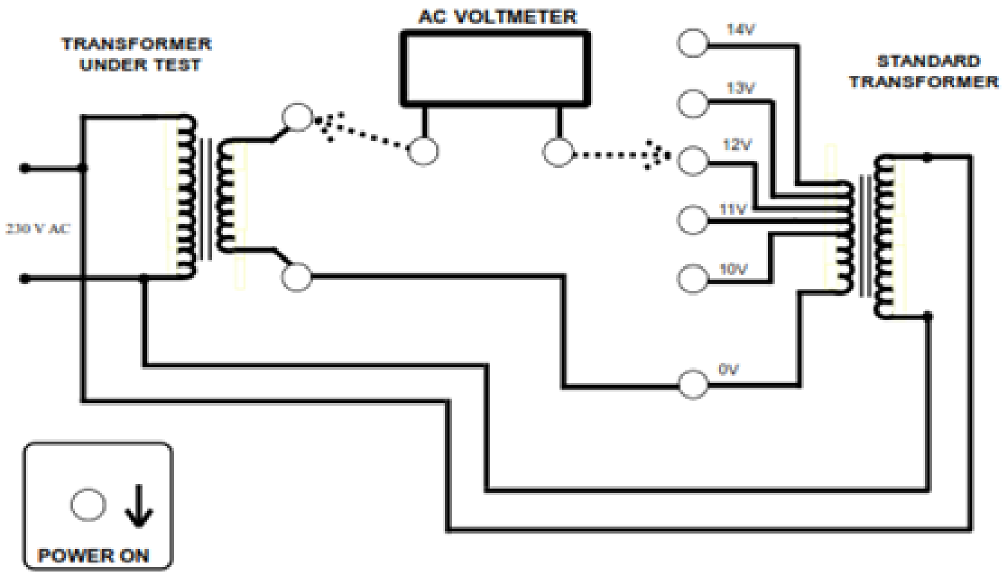


Figure 8.1: Turns Ratio Diagram.

LAB-9 MEASUREMENT OF REACTIVE POWER

9.1 Introduction

The reactive power of the single phase circuit is measured by the Varmeter (Volt ampere reactive meter). The varmeter is a type of the Electrodynamometer Wattmeter in which the pressure coil of the meter is made highly inductive.

9.2 Objective

To measure 3 - phase reactive power using single phase wattmeter.

9.3 Prelab Preparation:

Read the material in the textbook that describes reactive power using single phase wattmeter. Prior to coming to the lab, complete the Procedure

9.4 Equipment needed

Ammeter, UPF Wattmeter, Inductive Load, Three Phase Variac, Connecting Wires,

9.5 Procedure

1. Connect the circuit as per the circuit diagram.
2. Set three phase auto Transformer at zero voltage position before switching on the supply.
3. Gradually increase the voltage using the auto-transformer till the voltmeter reads rated line voltage.
4. Now apply the three phase balanced inductive load in steps.
5. For each step note down the Voltmeter, Ammeter, Wattmeter readings.
6. After noting the values slowly decrease the auto transformer till Voltmeters come to zero voltage position and switch off the supply.
7. Calculate the Error and draw the graph betweenError and load current

9.6 Further Probing Experiments

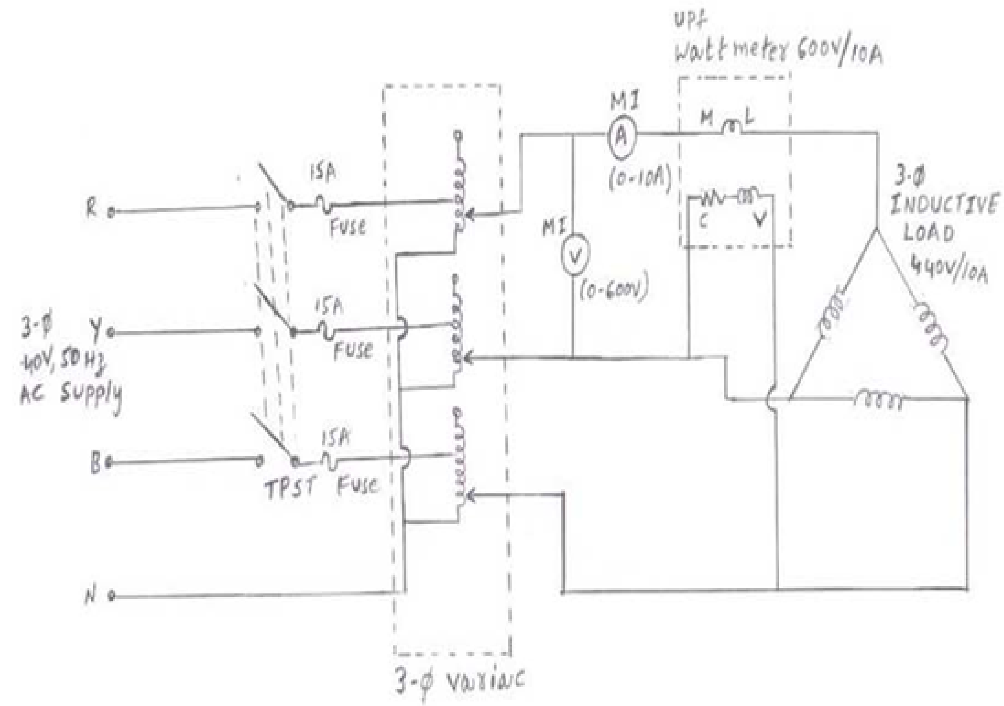


Figure 9.1: Circuit Diagram of Measurement of 3-Phase Reactive Power using Single Wattmeter.

LAB-10 C.T. TESTING USING MUTUAL INDUCTOR – MEASUREMENT OF PERCENT RATIO ERROR AND PHASE ANGLE OF GIVEN C.T. BY NULL METHO

10.1 Objective

Conduct an experiment on CT testing using mutual inductor for measurement of percent ratio error and phase angle by null method.

10.2 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

10.3 Equipment needed

Standard CT, Wattmeter, Ammeter, Rheostat, Load Burden.

10.4 Procedure

1. Connect the circuit as shown in the Figure
2. Primary of CT is connected across a low voltage supply at a non conducting Resistance Rp
3. The secondary of CT complete the circuit through a variable non-inductive resistance Rs.
4. The values of Rs and Rp are selected that the ratio of Rs to Rp is approximately equal to nominal ratio of CT.
5. The resistance Rp is adjusted so that full primary current flows while Rs is adjusted so that voltage drop across them is equal.
6. For obtaining Null deflection the magnitude and phase of both the voltage must be same.

10.5 Circuit Diagram

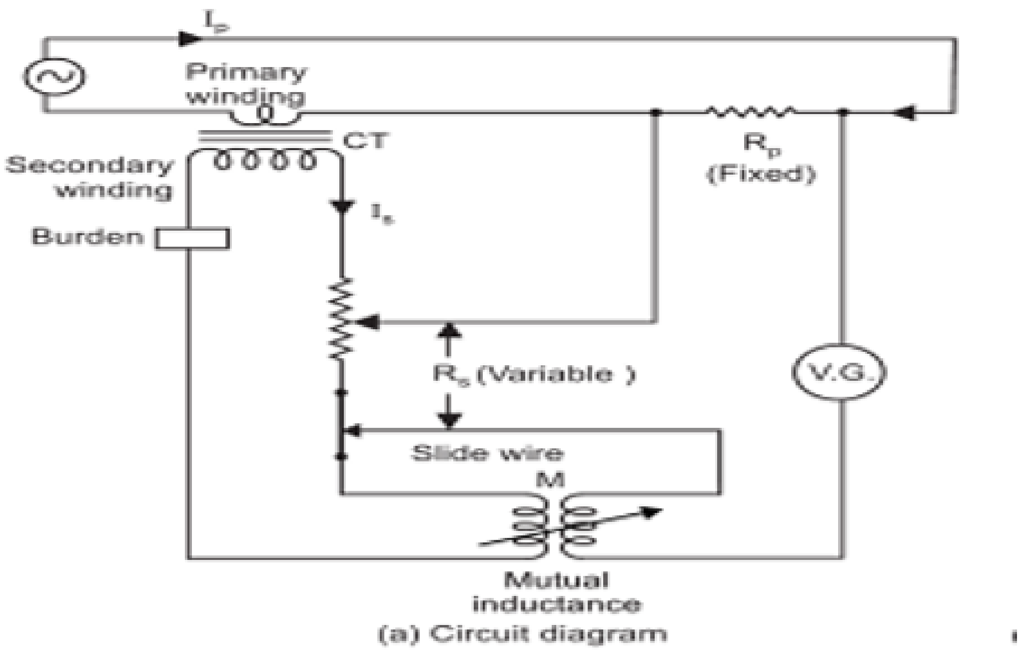


Figure 10.1:

TABULAR COLUMN:

S. No					
1					
2					
3					
4					
5					
6					

10.6 VIVA QUESTIONS:

1. Difference between the CT and PT.
2. What is ratio error?
3. What is phase angle error?
4. What is meant by mutual inductance?
5. What are types of testing of CT's?
6. What is meant by absolute method?

LAB-11 DC CROMPTON POTENTIOMETER

11.1 Objective

To calibrate PMMC Voltmeter and Ammeter by DC Crompton's potentiometer.

11.2 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

11.3 Equipment needed

DC Crompton's potentiometer Kit, Standard Cel, 2 Channel RPS, Voltmeter, Ammeter, Standard Resistance Box/DRB, Voltage Ratio Box, Galvanometer, Patch Chords.

11.4 Procedure

1. Connect the circuit as shown in the Figure
2. Primary of CT is connected across a low voltage supply at a non conducting Resistance Rp
3. The secondary of CT complete the circuit through a variable non-inductive resistance Rs.
4. The values of Rs and Rp are selected that the ratio of Rs to Rp is approximately equal to nominal ratio of CT.
5. The resistance Rp is adjusted so that full primary current flows while Rs is adjusted so that voltage drop across them is equal.
6. For obtaining Null deflection the magnitude and phase of both the voltage must be same.

11.5 Circuit Diagram

11.6 VIVA QUESTIONS:

1. Difference between the CT and PT.
2. What is ratio error?
3. What is phase angle error?

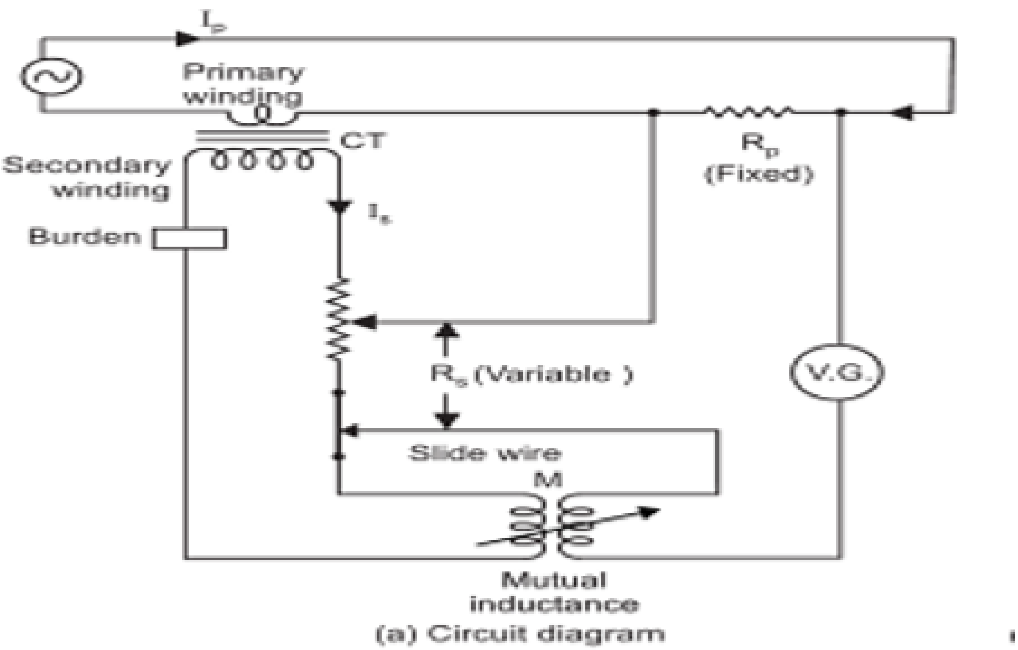


Figure 11.1:

TABULAR COLUMN:

S. No					
1					
2					
3					
4					
5					
6					

4. What is meant by mutual inductance?
5. What are types of testing of CT's?
6. What is meant by absolute method?

LAB-12 ANALYSIS OF WAVE FORMS, FREQUENCY AND THD USING DIGITAL SIMULATION

(A) ANALYSIS OF WAVE FORMS

12.1 Objective

Measurement of different parameters for given standard ac signals using LAB VIEW

12.2 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

12.3 Equipment needed

LABVIEW SOFTWARE

12.4 Theory

As well as knowing either the periodic time or the frequency of the alternating quantity, another important parameter of the AC waveform is Amplitude, better known as its Maximum or Peak value represented by the terms, Vmax for voltage or Imax for current. The peak value is the greatest value of either voltage or current that the waveform reaches during each half cycle measured from the zero baseline. Unlike a DC voltage or current which has a steady state that can be measured or calculated using Ohm's Law, an alternating quantity is constantly changing its value over time.

12.5 Procedure

1. Open a new VI. You can open a blank VI by selecting File» New VI.
2. Then you will see front panel and block diagram panel.
3. Right click on block diagram panel and select the different blocks according to the given block diagram
4. By using selected different blocks construct a complete block diagram .
5. Create indicators to the required measuring blocks.
6. Give the standard ac signals as input.

7. By double clicking on the simulate signal block change the wave forms to display different waveforms.
8. Run the program.
9. Note down the results from Front panel panel.

12.6 Block Diagram

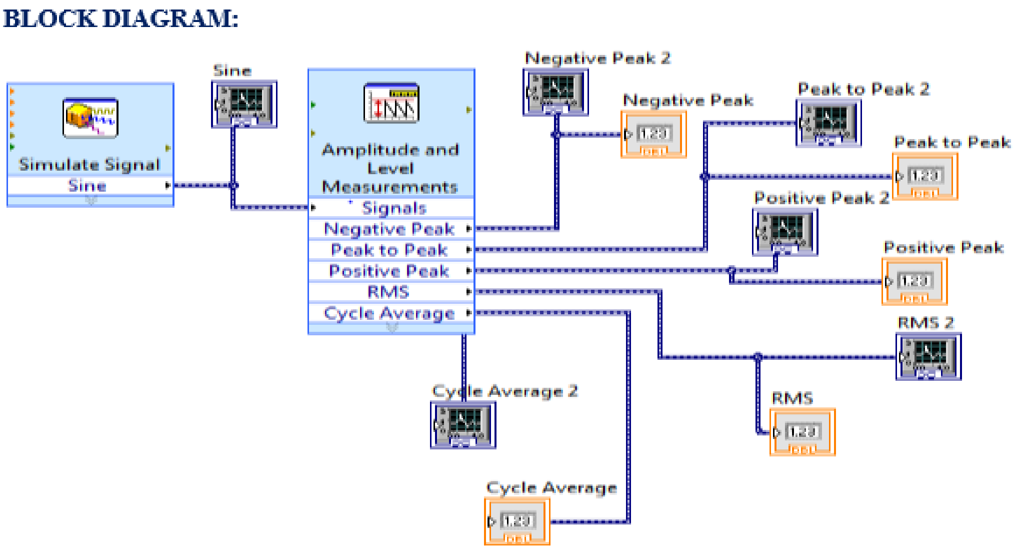


Figure 12.1:

12.7 VIVA QUESTIONS:

1. What is current?
2. Ohm's law is valid for what type of circuit?
3. What are the limitations of ohm's law?
4. What is Kirchoff's law?
5. What is Kirchoff's current law (KCL)?
6. What is Kirchoff's voltage law (KVL)?

(B) FREQUENCY AND THD USING DIGITAL SIMULATION

12.8 Objective

Determination of frequency and Total Harmonic Distortion (THD) using Lab VIEW

12.9 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

12.10 Equipment needed

LABVIEW SOFTWARE

12.11 Theory

Power sources act as non-linear loads, drawing a distorted waveform that contains harmonics. These harmonics can cause problems ranging from telephone transmission interference to degradation of conductors and insulating material in motors and transformers. Therefore it is important to gauge the total effect of these harmonics. The summation of all harmonics in a system is known as total harmonic distortion (THD).

12.12 Procedure

1. Open a new VI. You can open a blank VI by selecting File» New VI.
2. Then you will see front panel and block diagram panel.
3. Right click on block diagram panel and add simulate signal blocks and copy paste another simulate signal block.
4. Add a multiplier to the block diagram panel to perform modulation.
5. Add the amplitude level measurement block by right clicking on the block diagram panel to measure the positive negative peaks of a waveform.
6. Create indicators to the positive and negative peaks.
7. Give the standard values from theoretical calculations.
8. By double clicking on the simulate signal block change the wave forms to display different waveforms.
9. Note down the results from Front panel panel.

12.13 Block Diagram

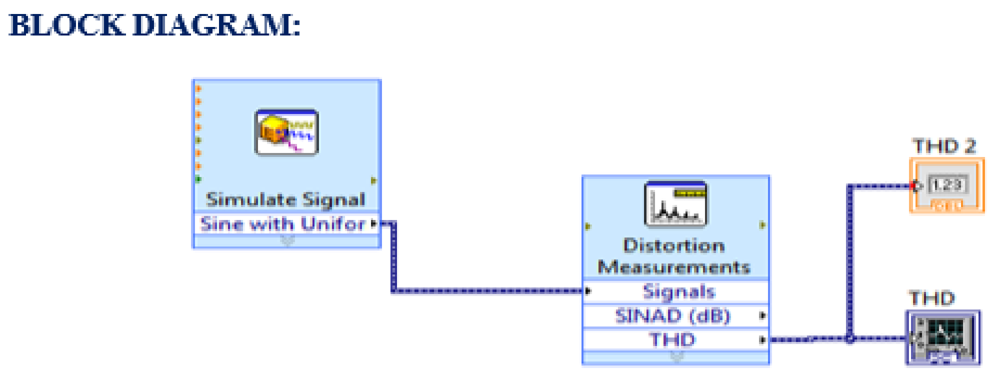


Figure 12.2:

FRONT PANEL:

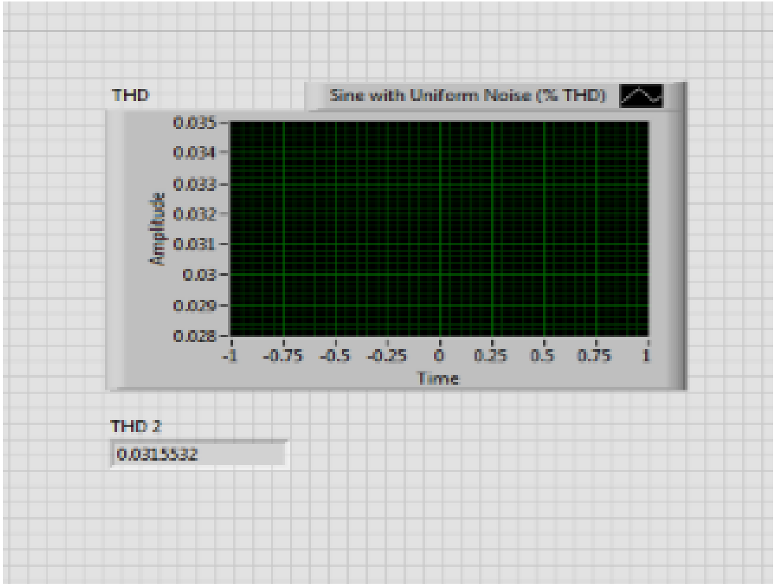


Figure 12.3:

12.14 VIVA QUESTIONS:

1. Define frequency
2. What are the units of frequency?
3. What is time period?
4. Define THD
5. How can you measure frequency THD?

LAB- 13 MEASUREMENT OF THREE PHASE POWER

13.1 Objective

To measure 3- phase power by using 1- phase wattmeter and two Current Transformers (CTs).

13.2 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

13.3 Equipment needed

Wattmeter, Current Transformers (CTs), Voltmeter, Ammeter, Resistive Load , Connecting wires.

13.4 Procedure

1. Connections are given as per the circuit diagram.
2. Supply is switched on.
3. Apply the different inductive loads
4. The meter readings are noted as per table given.

13.5 Circuit Diagram

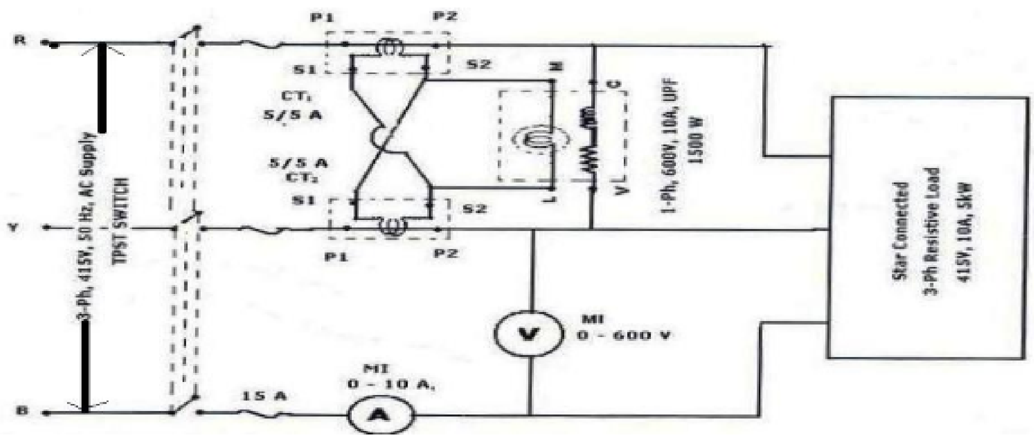


Figure 13.1:

TABULAR COLUMN:

S. No	Load (A)	Wattmeter Reading (W_L)	Ammeter Reading (I_L)	Voltmeter Reading (V_L)	Active Power
1					
2					
3					
4					
5					

13.6 VIVA QUESTIONS:

1. What is electrodynamometer type wattmeter?
2. What is meant by balanced load?
3. What is meant by unbalanced load?
4. What is instrument transformer?
5. Why instrument transformers are used?
6. What is meant by term “burden “of an instrument transformer?

LAB-14 WORKING OF STATIC ENERGY METER USING DIGITAL SIMULATION

14.1 Objective

Measurement of energy using a static energy meter and verification using LabVIEW.

14.2 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

14.3 Equipment needed

LABVIEW SOFTWARE

14.4 Theory

The energy meter has the aluminium disc whose rotation determines the power consumption of the load. The disc is placed between the air gap of the series and shunt electromagnet. The shunt magnet has the pressure coil, and the series magnet has the current coil.The pressure coil creates the magnetic field because of the supply voltage, and the current coil produces it because of the current.The field induces by the voltage coil is lagging by 90° on the magnetic field of the current coil because of which eddy current induced in the disc. The interaction of the eddy current and the magnetic field causes torque, which exerts a force on the disc. Thus, the disc starts rotating.The force on the disc is proportional to the current and voltage of the coil. The permanent magnet controls Their rotation. The permanent magnet opposes the movement of the disc and equalises it on the power consumption. The cyclometer counts the rotation of the disc.

14.5 Procedure

1. Open a new VI. You can open a blank VI by selecting File» New VI.
2. Then you will see front panel and block diagram panel.
3. Construct the block diagram as per the active power and reactive power equations Add a multiplier to the block diagram panel to perform modulation.
4. Add the amplitude level measurement block by right clicking on the block diagram panel to measure the positive negative peaks of a waveform.
5. Create indicators to the positive and negative peaks.

6. Give the standard values from theoretical calculations.
7. By double clicking on the simulate signal block change the wave forms to display different waveforms
8. Note down the results from Front panel panel.

14.6 Circuit Diagram

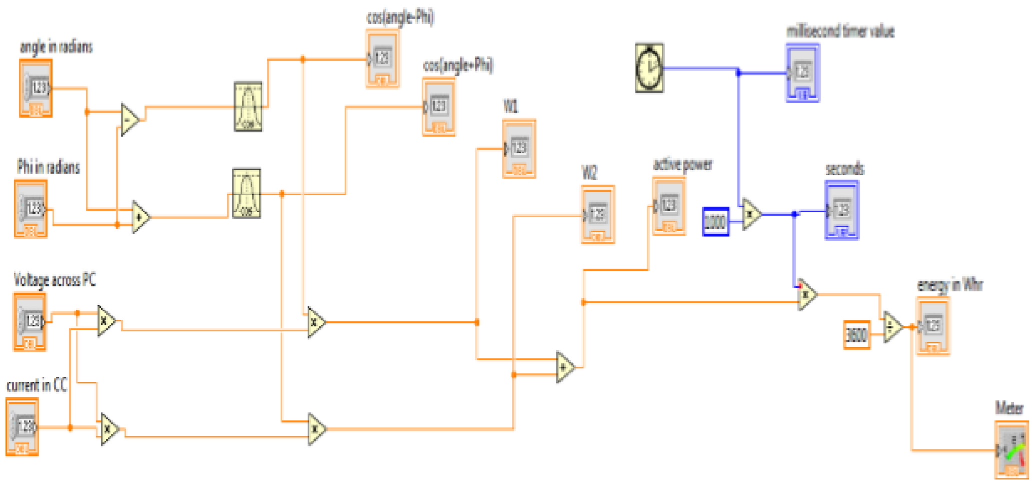
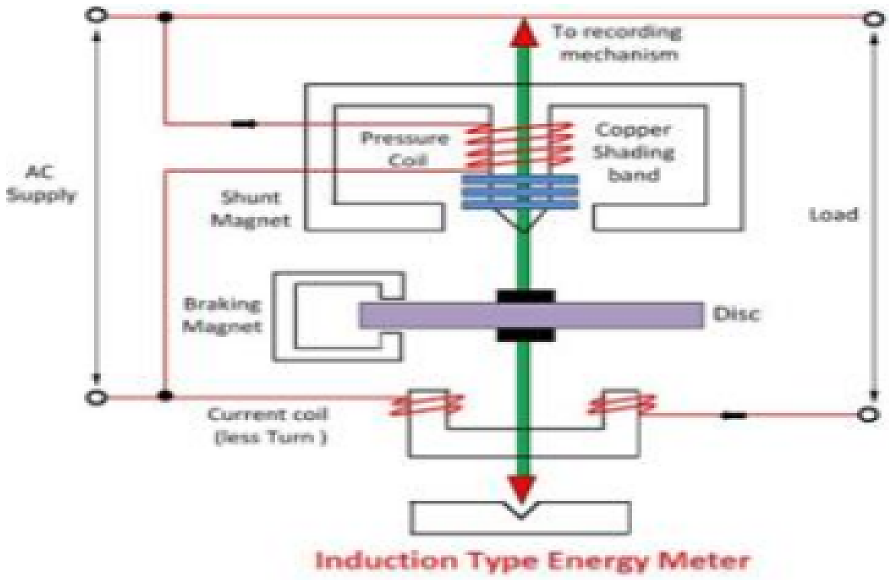
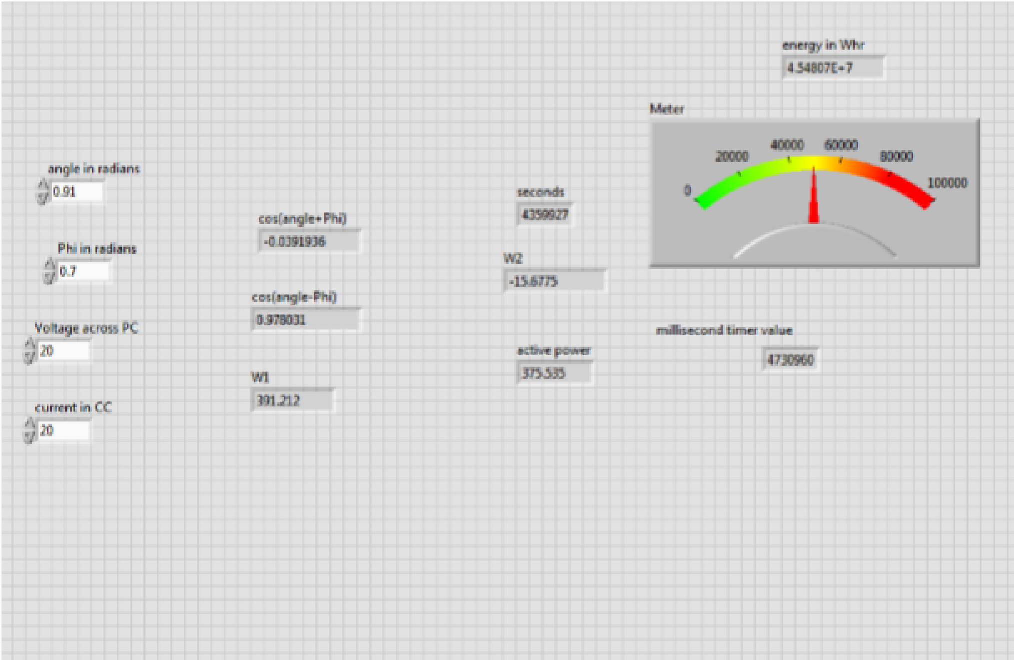


Figure 14.1:

14.7 Block Diagram



14.8 Front Panel



14.9 VIVA QUESTIONS:

1. What is the function of Static Energy Meter
2. What is the difference between Digital Energy meterand Static energy meter?
3. Why the KWH difference between both meters
4. What is the difference of static energy meter from ordinary energy meter?

LAB-15MEASUREMENT OF PASSIVE PARAMETERS USING DIGITAL SIMULATION

(A) MEASUREMENT OF CAPACITANCE:

15.1 Objective

capacitance measurement using Schering bridge using LabVIEW.

15.2 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

15.3 Equipment needed

LABVIEW SOFTWARE

15.4 Procedure

1. Open a new VI. You can open a blank VI by selecting File» New VI.
2. Then you will see front panel and block diagram panel.
3. Right click on block diagram panel and add simulate signal blocks and copy paste another simulate signal block.
4. Add the amplitude level measurement block by right clicking on the block diagram panel to measure the positive negative peaks of a waveform.
5. Create indicators to the positive and negative peaks.
6. Give the standard values from theoretical calculations.
7. By double clicking on the simulate signal block change the wave forms to display different waveforms.
8. Note down the results from Front panel panel.

15.5 Circuit Diagram

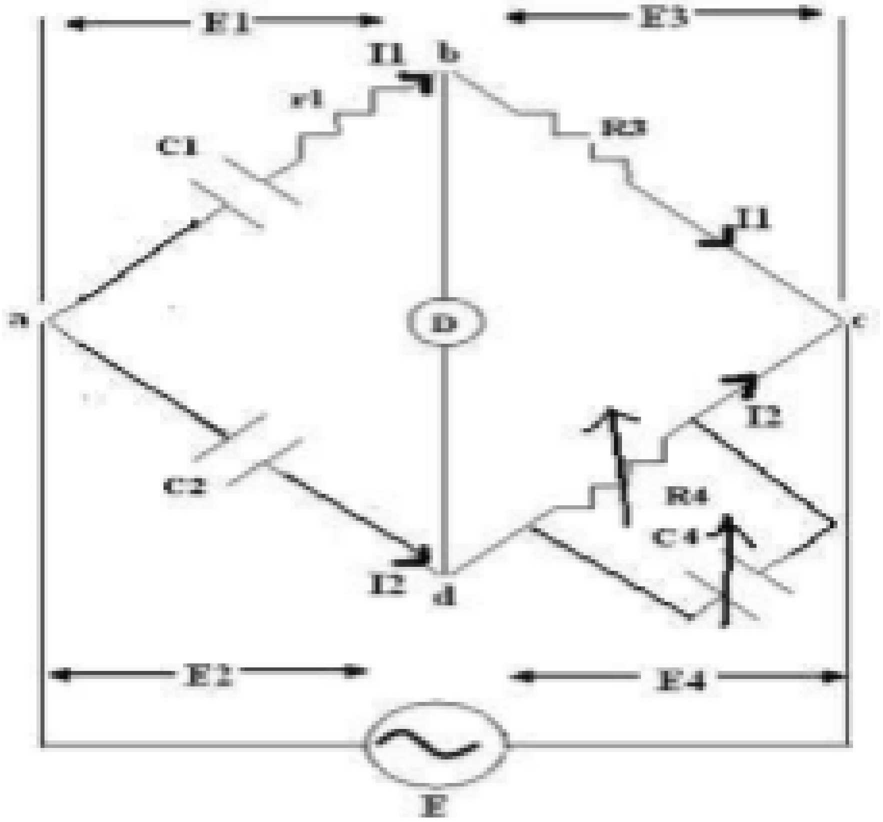


Figure 15.1:

15.6 VIVA QUESTIONS:

1. In two wattmeter method if one wattmeter shows Negative reading then what is reason?
2. What is the reason for low voltage in houses?
3. What is meant by current and voltage? What is difference between the two?
4. What do you mean by the 3phase wattmeter?
5. Explain the short how the wattmeter is connected in the circuit to measure

B) ANDERSON'S BRIDGE

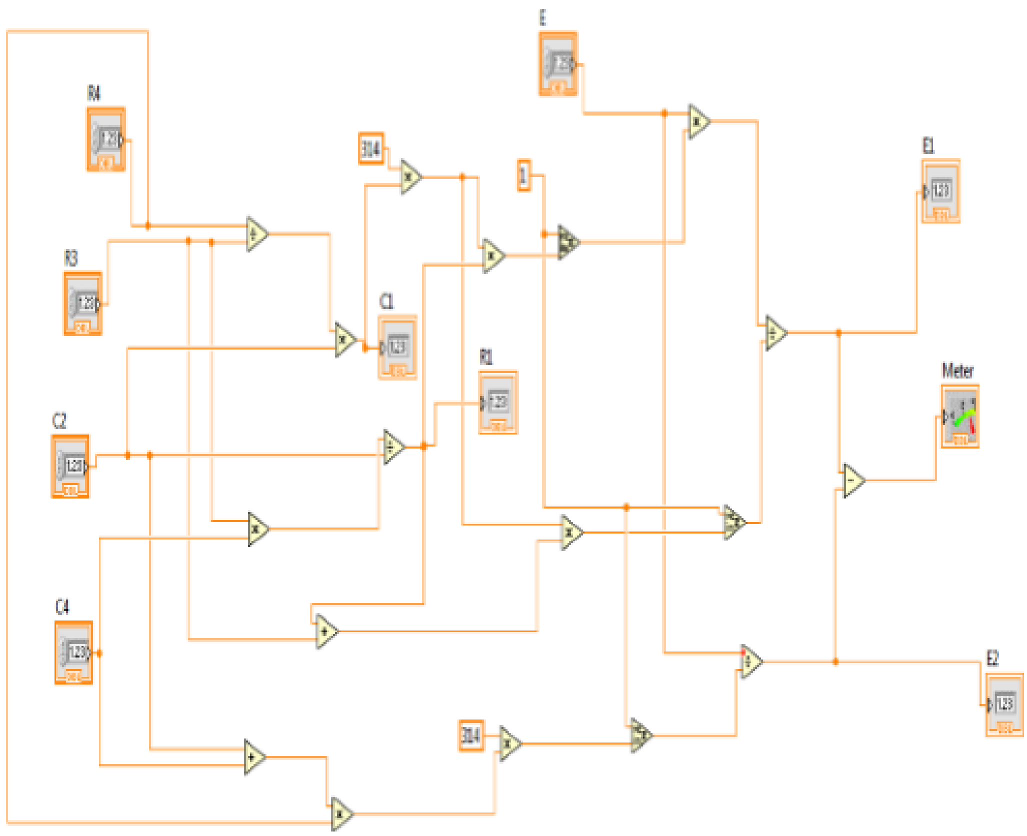
15.7 Objective

Inductance measurement using Anderson bridge using LabVIEW.

15.8 Prelab Preparation:

Read the material in the textbook that describes Kelvin's double bridge. Prior to coming to the lab, complete the Procedure.

BLOCK DIAGRAM:



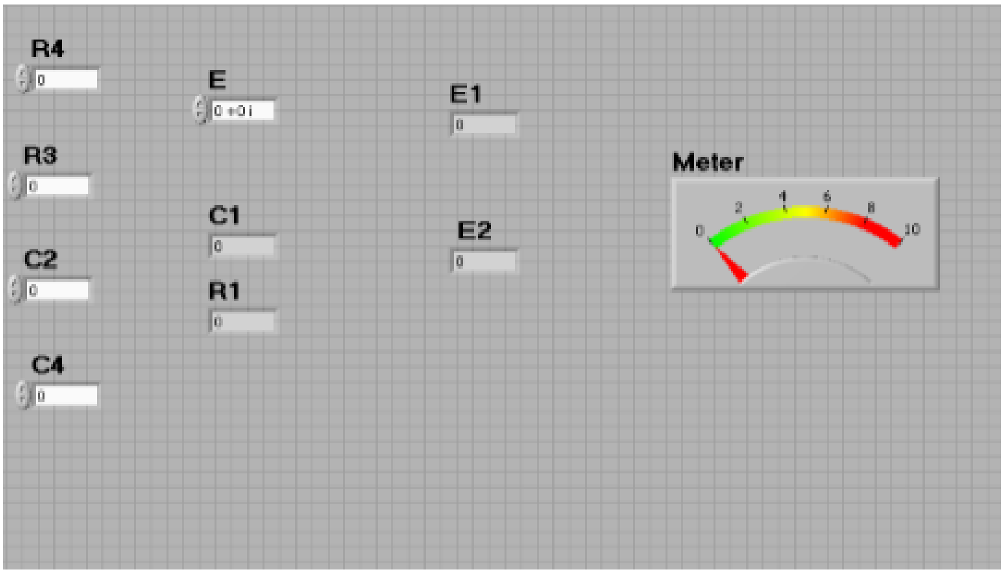
15.9 Equipment needed

LABVIEW SOFTWARE

15.10 Procedure

1. Open a new VI. You can open a blank VI by selecting File» New VI.
2. Then you will see front panel and block diagram panel.
3. Right click on block diagram panel and add simulate signal blocks and copy paste another simulate signal block.
4. Add a multiplier to the block diagram panel to perform modulation.
5. Add the amplitude level measurement block by right clicking on the block diagram panel to measure the positive negative peaks of a waveform.
6. Create indicators to the positive and negative peaks.
7. Give the standard values from theoretical calculations
8. By double clicking on the simulate signal block change the wave forms to display different waveforms.
9. Note down the results from Front panel panel.

FRONT PANEL



15.11 Circuit Diagram

15.12 VIVA QUESTIONS:

1. In two wattmeter method if one wattmeter shows Negative reading then what is reason?
2. What is the reason for low voltage in houses?
3. What is meant by current and voltage? What is difference between the two?
4. What do you mean by the 3phase wattmeter?
5. Explain the short how the wattmeter is connected in the circuit to measure

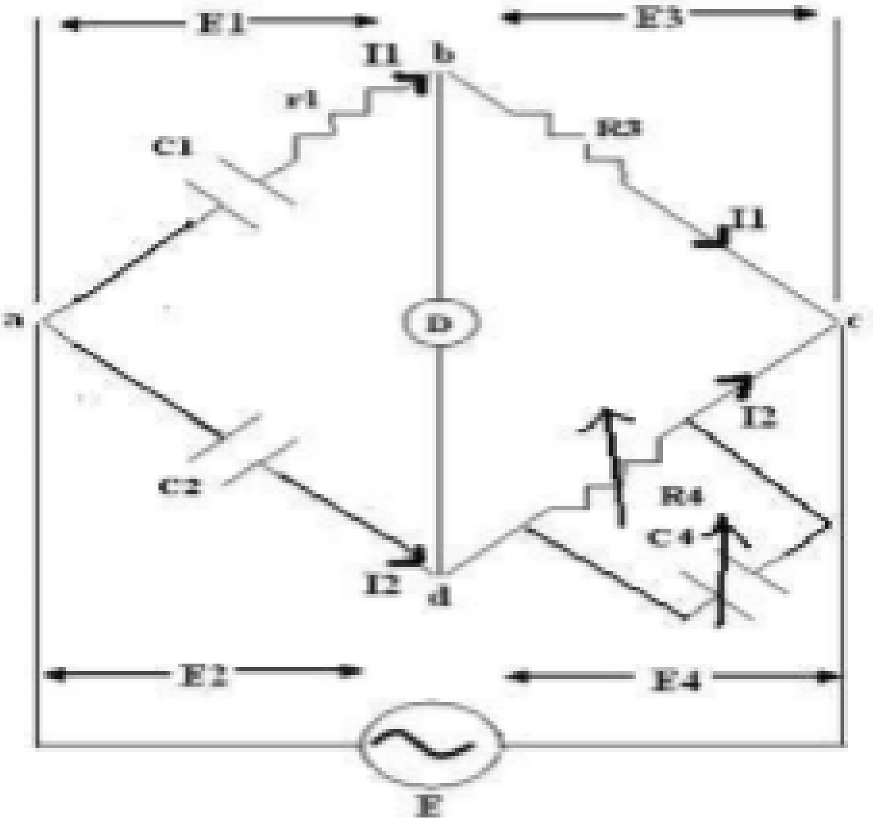
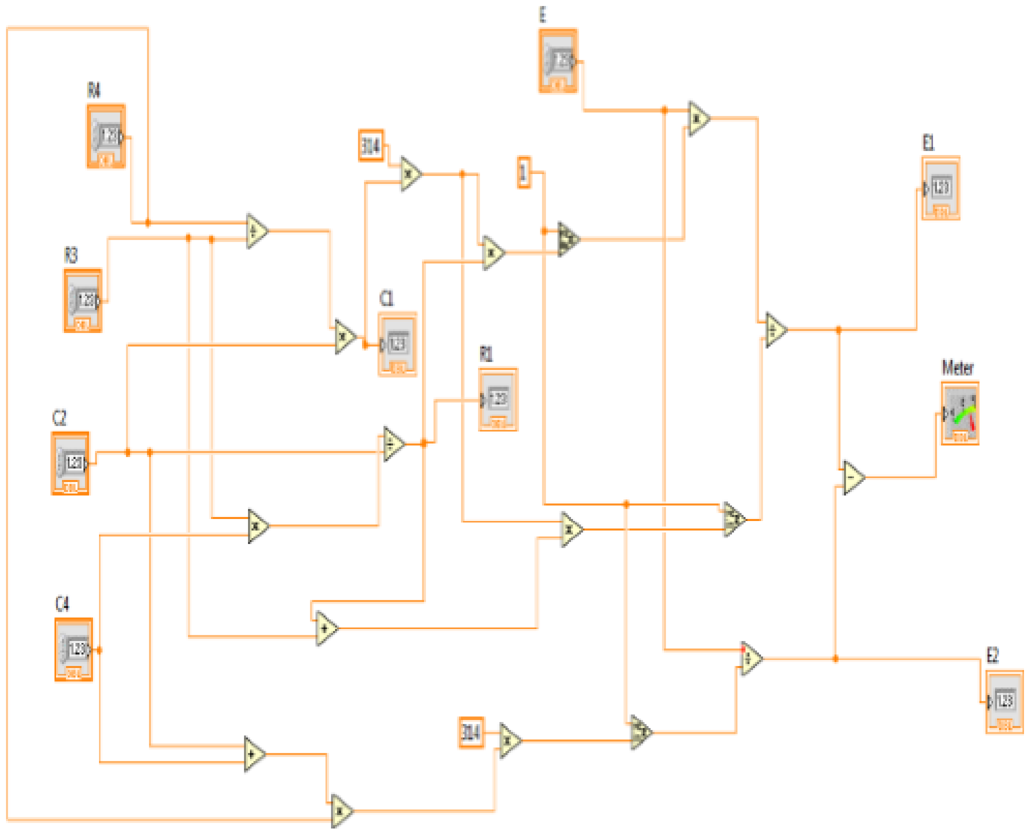


Figure 15.2:

BLOCK DIAGRAM:



FRONT PANEL