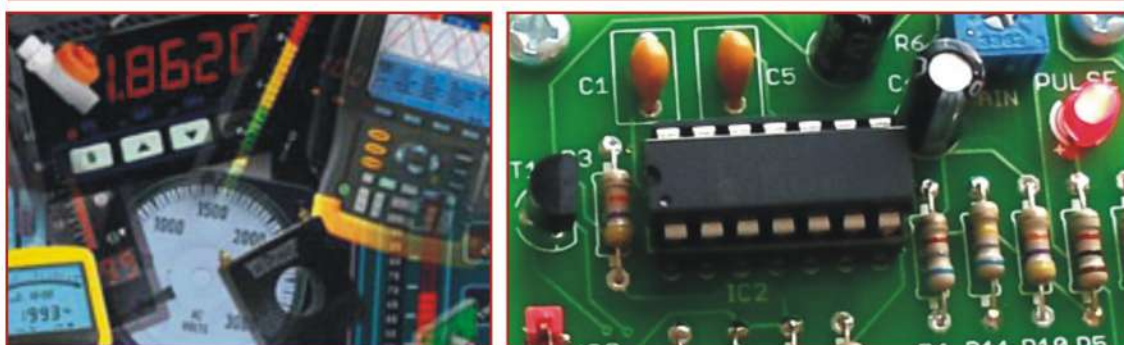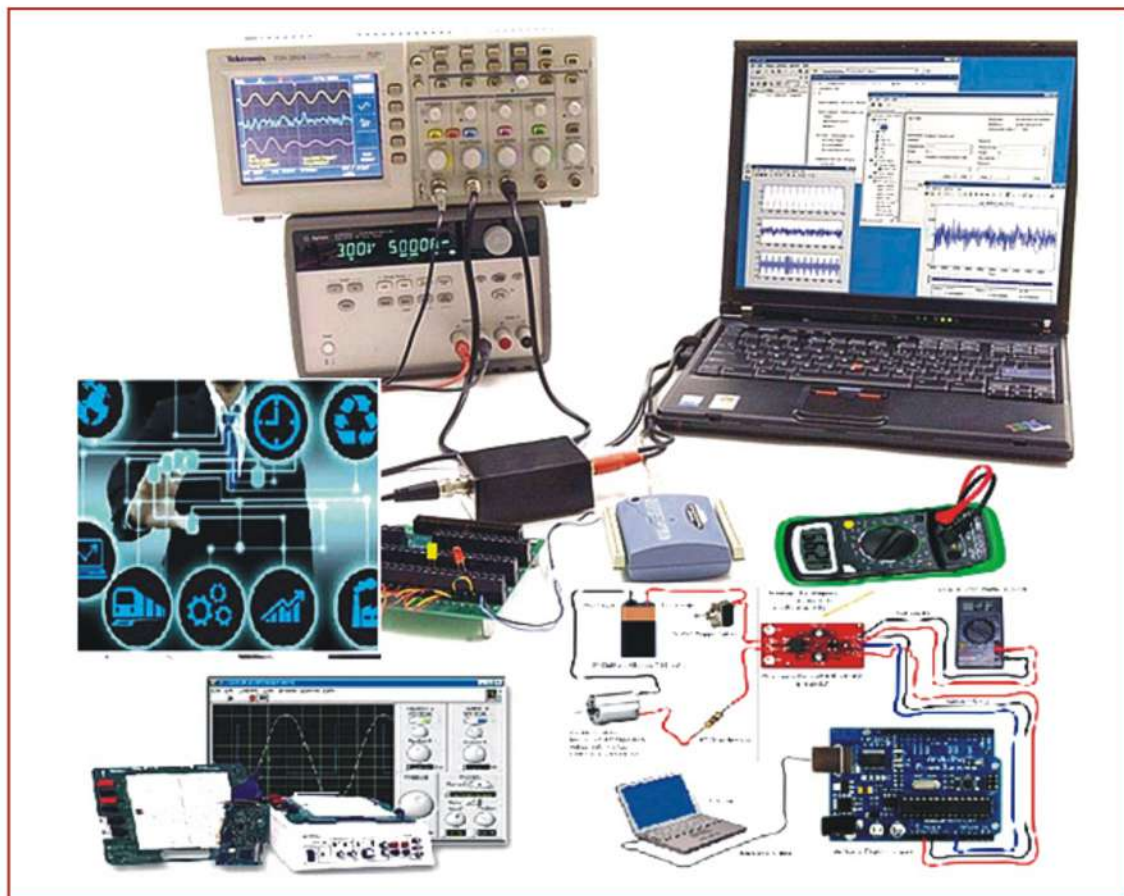# SENSORS MEASUREMENTS AND INSTRUMENTATION LABORATORY MANUAL

Department of Electrical and Electronics Engineering

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)

SENSORS MEASUREMENTS & INSTRUMENTATION LAB

Gokaraju Rangaraju Institute of Engineering & Technology
Bachupally

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)
Bachupally, Hyderabad-500 072

CERTIFICATE

This is to certify that it is a bonafide record of practical work done in the Sensors Measurements and Instrumentation Laboratory during the year ……….....

Name:
Roll No:
Branch:

Signature of staff member

Contents:

S.No.	NAME OF EXPERIMENT	PAGE No.	SIGN
1	Measurement of Resistance using a bridge technique.		
2	Measurement of Inductance using a bridge technique.		
3	Measurement of Capacitance using a bridge technique		
4	Measurement of one-cycle data of a periodic waveform using DSO and function generator to compute the RMS value.		
5	Measurement of Voltage and Current Detection Circuitry		
6	Measurement of Power and Energy		
7	Position Indication using LVDT		
8	Temperature, Pressure & Humidity Detection		
9	Light sensor		
10	Accelerometer sensor		
11	Rain fall & Soil Moisture sensor		
12	Distance(ultrasonic) sensor		

1. MEASUREMENT OF RESISTANCE USING A BRIDGE TECHNIQUE.

AIM: To determine the value of the resistance of given Kelvin Double Bridge

APPARATUS:

> Kelvin's Bridge kit
>
> DC Power supply
>
> Rheostat
>
> Standard resistance boxes
>
> Galvanometer

THEORY:

The Kelvin's Double Bridge (KDB) is a modification of the wheat stone Bridge (WB) and provides increased accuracy in the measurement of low resistance's.   The resistance of which is a major source of error in the WB is overcome in this method. The KDB incorporates the idea of a second set of ratio arms –hence the name Double Bridge –and the use of four –terminal resistor for the law resistance arms. As shown in the figure the first of ratio arms is P & Q. The second set of ratio arms, P and V, is used to connect the galvanometer to point D at the appropriate potential between points M and N to eliminate the effect of connecting lead of resistance R between the known resistance R and the Standard Resistance S. The ratio P/Q is made equal to p/q. under balance conditions there is no current through the Galvanometer, which means that the voltage drop between a and b, Eab is equal to the voltage drop E and I between a and c.

The last equation indicates that the resistance of connecting lead, r has no effect on the measurement. Provided that the two sets of ratio arms equal ratios. The last but one equation above, shows that the error that is introduced in case the ratios are not exactly equal it indicates that it is desirable to keep as possible to minimize the errors in case there is a difference between ratios. P/Q and p/q.

The effect of thermos electric EMFs can be eliminated by making another measurement

with the battery connections revered. The true value of R being the mean of the two readings.

CIRCUIT DIAGRAM:
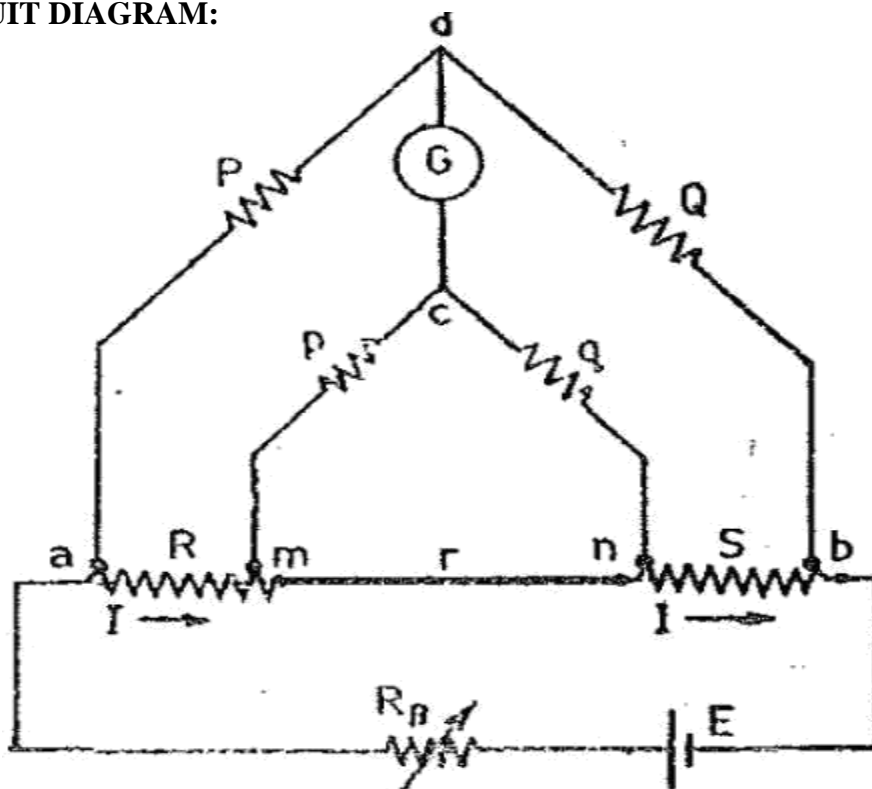
P, p, Q, q –Known decade resistances

R –Unknown resistance whose value is to be determined.

S –Standard resistance.

Rb –Regulating resistance.

G –Galvanometer.

K –Key switch.

PROCEDURE:

1. The connections as per the circuit diagram.

2. Keep Q = q = 1000 ohms and S = 1 ohm. The ratio P/Q should
   a. always be kept equal to p/q. as Q =q, we must keep P = p.
   b. To start with P and p may be kept at zero position.

3. Switch on the DC power supply and adjust the voltage to about 2
   a. volts with the regulating resistance cut in fully.

4. Adjust P and p simultaneously to get balance. If a light spot

5. Galvanometer is used, then increases the sensitivity in steps and
   a. get exact balance in the direct portion. Bring back the sensitivity
   b. Knob of the galvanometer to the starting position.

6. Note the value of P.

7. Repeat steps (3) and (4) reversing the DC power supply polarity.

8. Repeat steps (3) to (5) above fo

9. Q = q = 100 ohms, 10 ohms, 1 ohms choosing suitable values for S
   a. So that the value of p at balance is obtained in hundreds.

10. The unknown resistance is calculated in each case using the Formula R = P/Q.S

TABULAR COLUMN:

S.No	Main dial	Slide wire	Multiplier

RESULT:

2. MEASUREMENT OF INDUCTANCE USING A BRIDGE TECHNIQUE.

AIM: To determine the self-inductance of the coil (L) using Anderson's bridge.

APPARATUS: Anderson's Bridge kit, Patch Chords, Headphones, Inductance Box.

THEORY:

This is modified version-inductance of Maxwell's is measured in bridge comparison with a capacitance. This method, using Anderson Bridge, is helpful in determining accurately inductance values over a wide range. The bridge network as shown in fig

L is the Unknown inductance and S its self-non-inductive resistance.
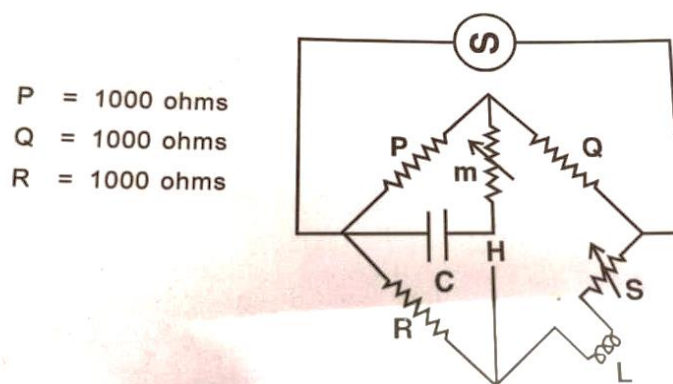
C is a Standard capacitor.

P, Q and R are known non-inductive resistors.

m is the variable resistor.

The detector normally used is headphone.

The balancing of the bridge is done follows:

CIRCUIT DIAGRAM:

P = 1000 ohms
Q = 1000 ohms
R = 1000 ohms

Anderson's Bridge

Different values of L can be calculated from the formula: -

L=C [RQ+(R+S) m]

Where L is in Henries, C in Farads and other resistances are in ohms

The Bridge is useful for measuring small values of inductances only

PROCEDURE:

1. Connect an Audio oscillator and headphones to the proper terminals provided on circuit
2. Select a certain value of C say equal to 0.01mfd, now get a null point by adjusting S and m alternatively
3. Repeat the process, change the C value if m is not sufficient
4. The experiment for the same inductance can be repeated by selecting different value of C , and getting balance by varying S and m
5. The mean value of L can be calculated

OBSERVATION:

PRECAUTIONS:

1. The value of capacity C should be small so as to allow sufficient variation of m
2. In all calculations, the value of S should include the resistance of self-inductance
3. There cannot be perfect silence in the headphones, only minimum sound should be tried for
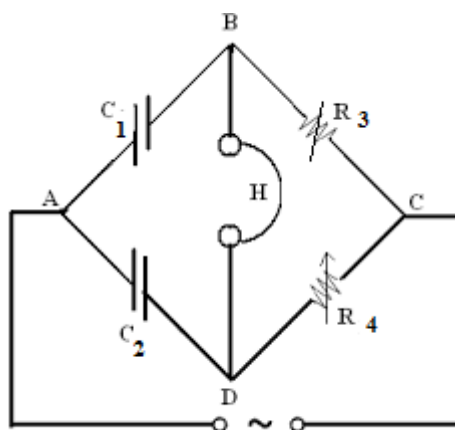4. Numerical value of L should be greater than CRQ if m is to be positive

RESULT:

3. MEASUREMENT OF CAPACITANCE USING A BRIDGE TECHNIQUE.

AIM: To determine the unknown value of capacitance using Desauty's bridge.

APPARATUS: De-Sauty's Bridge kit, Patch Chords, Headphones, Capacitance Box.

CIRCUIT DIAGRAM:

De-Sauty Bridge

THEORY:

The bridge is the simplest of comparing two capacitances. This bridge is useful for comparison of Loss-free capacities by using a null detection method by using an A.F.Oscillator of 1 K.C./second a pair of headphones .

The bridge is a modification of a Wheat stone bridge

ARMS of the Bridge as follows
(i). The first arm AB contains loss free u known capacitance C_1

(ii). The second arm A D contains a known capacitance in the form of single decade of 10 X   0.01 mfd

(iii) The third arm B C contains a non- inductive variable Resistance R_3 in the form of 3 decades of 10 x 10 , 10X 100, 10   x 1000 ohms

(iv) The third arm C D contains a non- inductive variable Resistance R4 in the form of 3 decades of 10 x 10 , 10X 100, 10   x 1000 ohms

The balance can be obtained by varying either R_3 or R_4 with C_1 and C_2 respectively.

PROCEDURE:

1. Connect the circuit as shown in the figure.
2. Connect the unknown capacitor in C_1.
3. Select any value of R_3.
4. Connect the multimeter between ground and output of imbalance amplifier.
5. Vary R4 from minimum position, in clockwise direction.
6. If the selection of R_3 is correct the balance point can be obtained at minimum position.
7. If that is not the case, select another R_3.
8. Since, the unknown capacitance whose resistive effect would be made for capacitive form
9. At null point by keeping C_2 at a certain value for example set $C_2 = 0.01mF$
   $C_1 = R_4C_2/R_3$

OBSERVATION:

S.NO	R_3	R_4	C_2	$C_1 = R_4C_2/R_3$	True value of C_1

RESULT:

4. MEASUREMENT OF ONE-CYCLE DATA OF A PERIODIC WAVEFORM USING DSO AND FUNCTION GENERATOR TO COMPUTE THE RMS VALUE.

**AIM:** To measure RMS value of a given signal in DSO.

APPARATUS:
    DSO
    Function Generator

THEORY:

So many of the experiments in the advanced labs make use of oscilloscopes and function generators that it is useful to learn their general operation. Function generators are signal sources which provide a specifiable voltage applied over a specifiable time, such as a "sine wave" or "triangle wave" signal. These signals are used to control other apparatus to, for example, vary a magnetic field superconductivity and NMR experiments) send a radioactive source back and forth or act as a timing signal, i.e., "clock" (phase-sensitive detection experiment).Oscilloscopes are a type of signal analyzer—they show the experimenter a picture of the signal,usually in the form of a voltage versus time graph. The user can then study this picture to learn the amplitude, frequency, and overall shape of the signal which may depend on the physics being explored in the experiment.

Both function generators and oscilloscopes are highly sophisticated and technologically mature devices. The oldest forms of them date back to the beginnings of electronic engineering, and their modern descendants are often digitally based, multifunction devices costing thousands of dollars. This collection of exercises is intended to get you started on some of the basics of operating 'scopes and generators, but it takes a good deal of experience to learn how to operate them well and take full advantage of their capabilities.

DIAGRAMS:
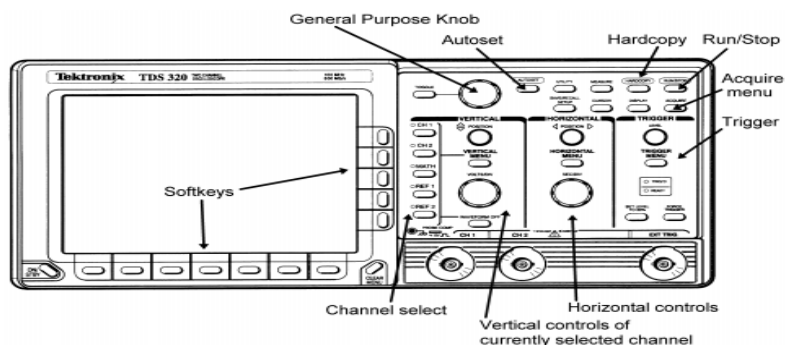

Front Panel view of DSO

CONNECTION DIAGRAM:
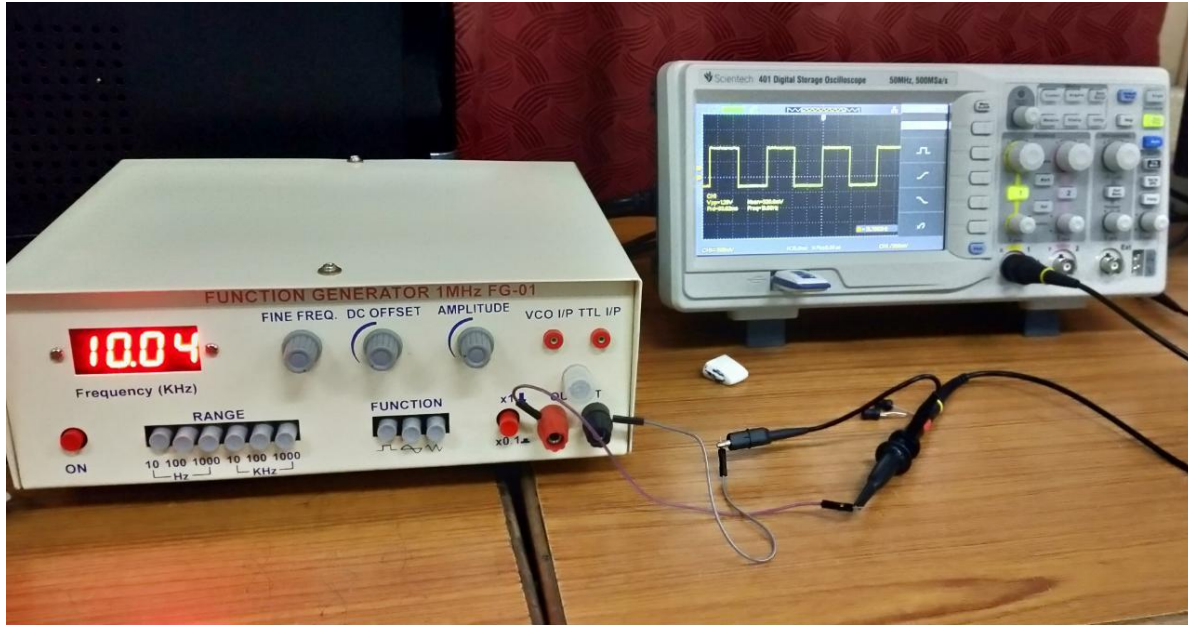
Connection Diagram showing the CSO and Function generator connections

PROCEDURE:
1. Connect the output of function generator to DSO using probes.
2. Switch ON the supply of DSO & Function generator.
3. Apply the Square signal to the DSO.
4. Press '**AUTO**' button in the DSO.
5. Select Measure→Volatge→Vrms.
6. Observe the value of Vrms value in DSO.
7. Repeat the process for various waveforms

THEORETICAL CALCULATIONS:

EXPECTED WAVEFORMS:
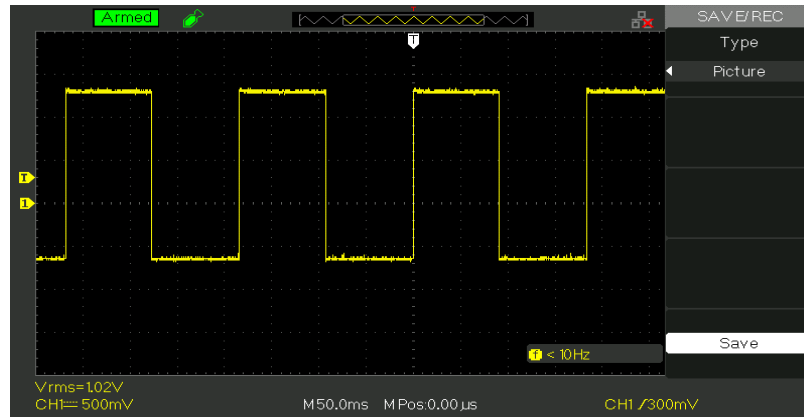
a) Square signal
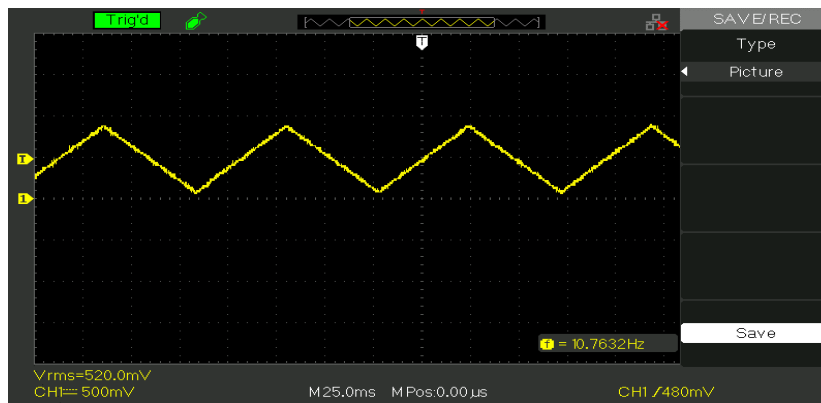
b) Triangular signal
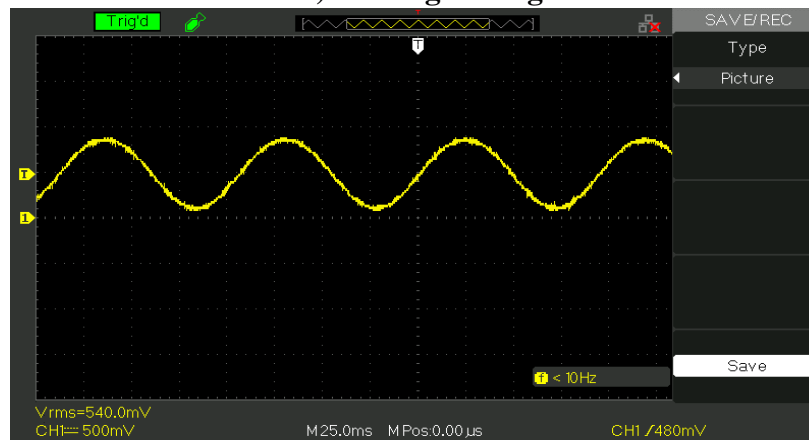
c) Sine Signal

GRAPH SHEET:
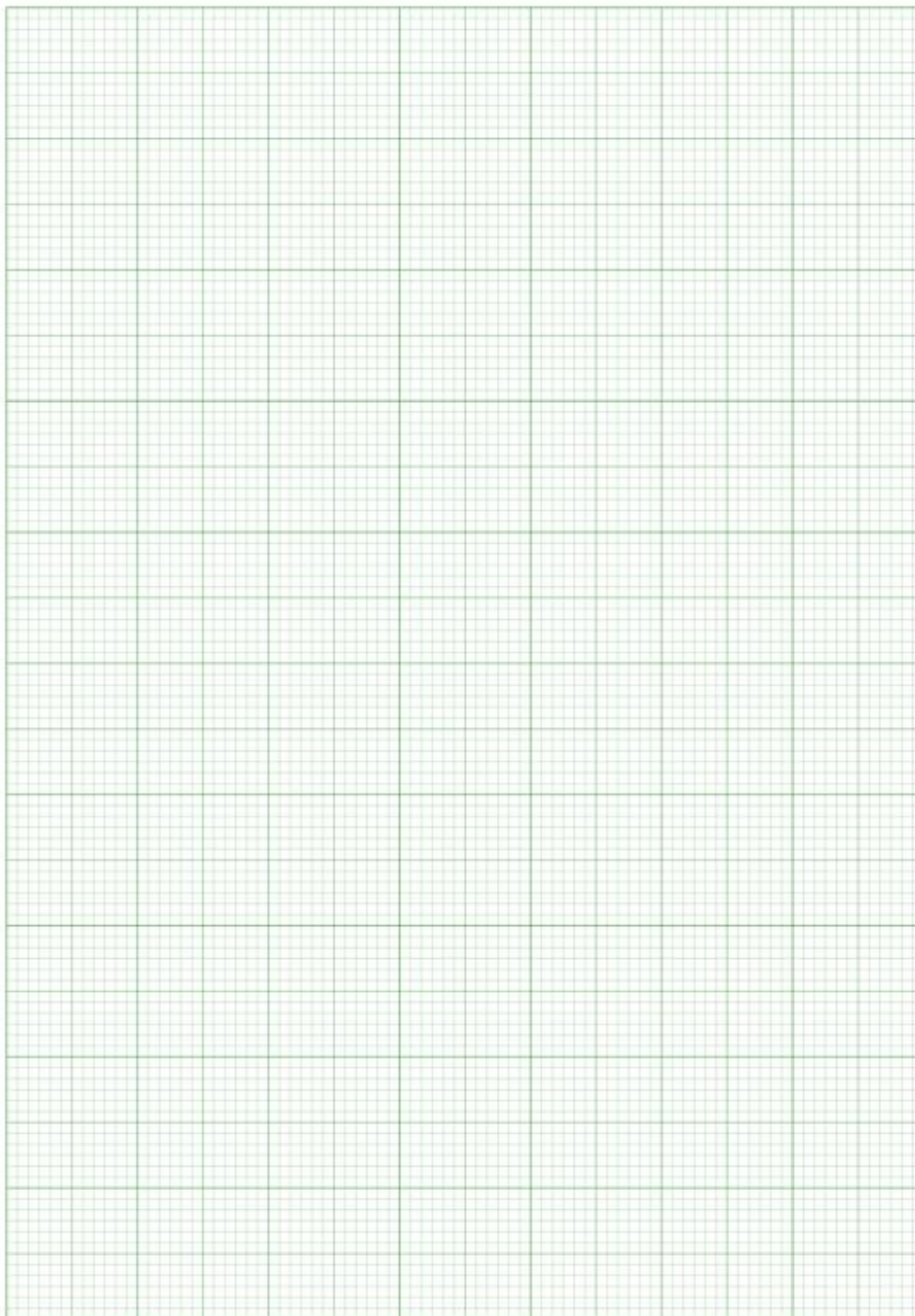
RESULT:

5. MEASUREMENT OF VOLTAGE AND CURRENT DETECTION CIRCUITRY

AIM: To sense the voltage across the Battery and Current through the Divider Circuit Using Arduino

APPARATUS: 1) Arduino UNO board
              2) Two Resistors 1kΩ each

              3) Small Bread Board
              4) Connecting wires
              5) Arduino software

CIRCUIT DIAGRAM:
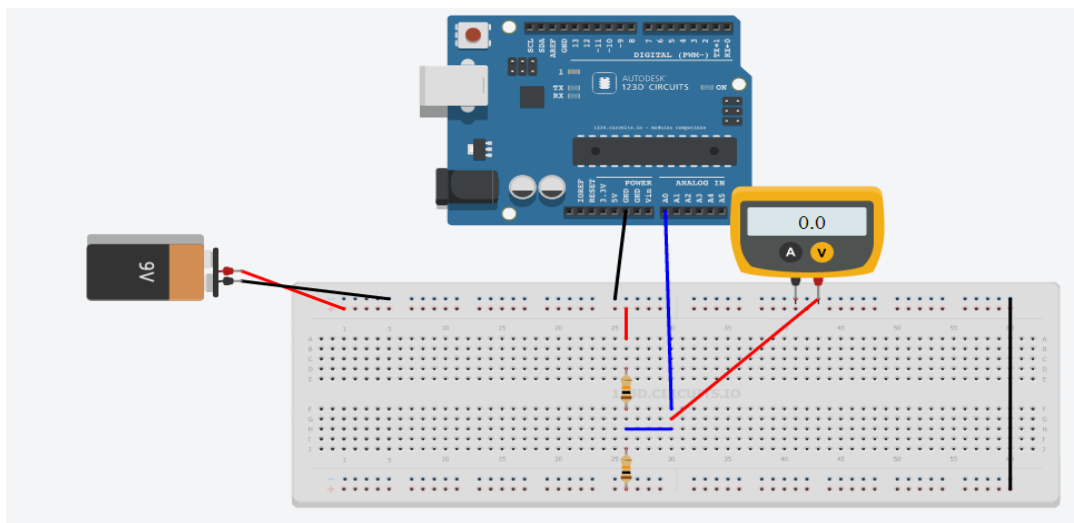
Voltage sensing circuit using Arduino

THEORY:
The Arduino can accept up to 5v on a analog input. Our battery voltage can range as high as 9vdc in certain charge cycles, so we designed a voltage divider that would provide 5v at 9v battery voltage, and less at various lower voltages
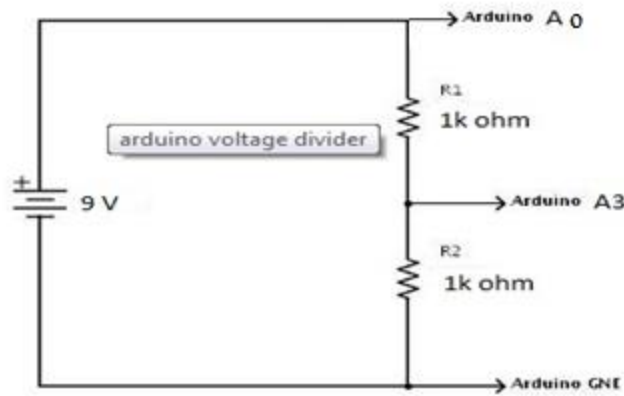
Divider Circuit
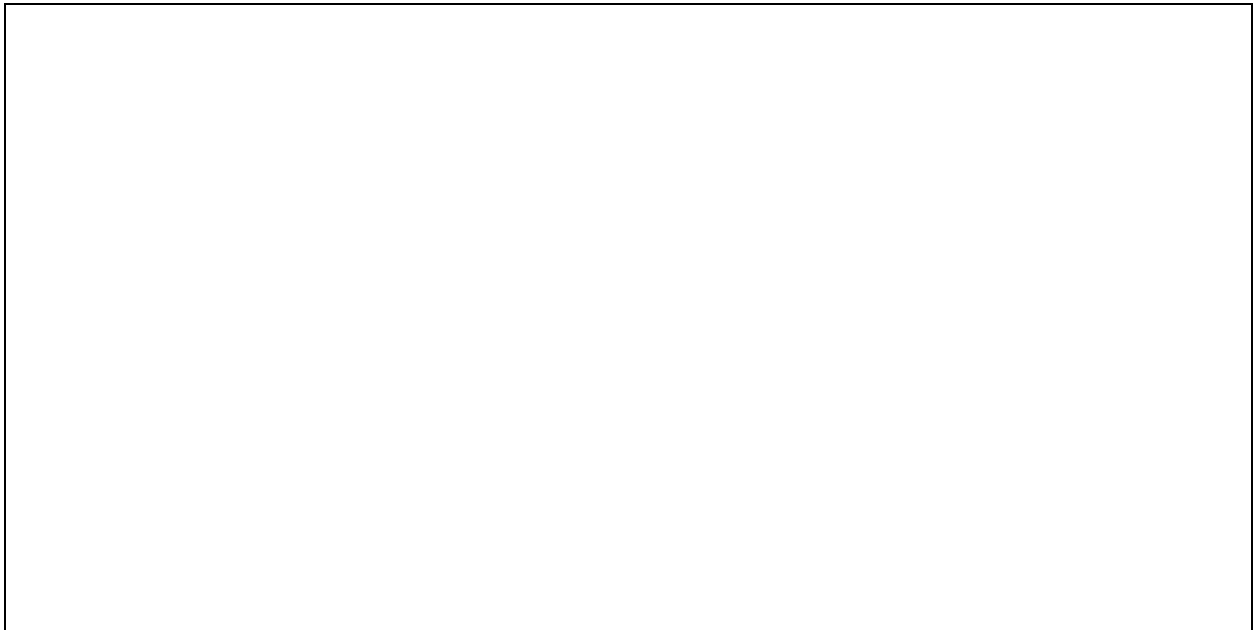
PROGRAM:
```
int sensorPin = A0;    // select the input pin for the potentiometer
int sensorValue = 0;  // variable to store the value coming from the sensor
int sensorPin1 = A3;    // select the input pin for the divider
void setup() {
 pinMode(sensorPin, OUTPUT);
pinMode(sensorPin1, OUTPUT);
Serial.begin(9600);
 }
void loop() {
  // read the value from the sensor:
 sensorValue = analogRead(sensorPin);
Serial.print("Battery voltage:");
int sensorValue1=sensorValue*5/1023
Serial.println(sensorValue1);
  delay(1000);
 }
```

Write Program for Current Detection

OBSERVATIONS:
SERIAL MONITOR:

RESULT:

6. MEASUREMENT OF POWER AND ENERGY

AIM: To calibrate the given energy meter using a wattmeter.

APPARATUS:

S.No	Equipment	Range	Type	Quantity
1	Variac,single phase	10 A	AC	
2	Voltmeter	300 V	AC	
3	Ammeter	0-10A	AC	
4	Load(R,L,C)		AC	
5	Wattmeter	LPF	AC	
6	Single phase energy meter	10A	AC	

THEORY:

The calibration of energy meter may become inaccurate during its vigorous use due to various reasons. It is necessary to calibrate the meter to determine the amount of error i.e. its reading so that same meter can be used for correct measurement of energy .In this method precision grade indicating instruments are used as reference standard. These indicating instruments are connected in the circuit of meter under test. The current and voltages are held constant during the test. The numbers of revolutions made by the test are recorded. The time taken is also measured.
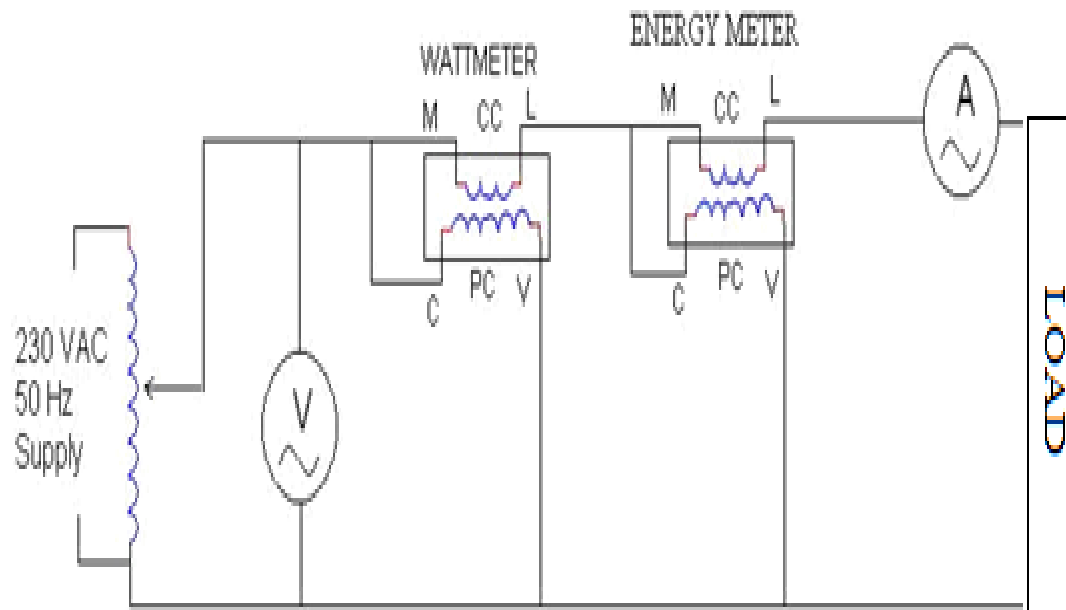
Energy recorded by meter under test = RX / KX kWh.

Energy computed from the readings of the indicating instrument = kW × t
Where RX = number of revolutions made by disc of meter under test.
  KX = number of revolutions per kWh for meter under test,
  kW = power in kilowatt as computed from readings f indicating instruments
  t = time in hours.

CIRCUIT DIAGRAM:

Load Connected to single phase supply

PROECEDURE:

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 Auto transformer in clockwise direction.

5. Adjust the load rheostat so that sufficient current flows in the circuit. Please note that the current
   should be less than 4A.

6. Note down the Voltmeter, Ammeter, Wattmeter and power factor meter readings for different Voltages as per the tabular column.

7. Note down the time (by using stop watch) for rotating the disc of the Energy Meter for 10 times

TABULAR COLUMN

S. No.	Voltage (V)	Current (I)	R = No of revolutions of the disc	Time (t) in hours	Energy meter reading in KWh= No. revolution (R)/meter constant (K)	Wattmeter Reading in kW × t

RESULT:

7. POSITION SENSOR USING LVDT

AIM: To study the working of a linear variable differential transformer (LVDT).

APPARATUS:

        LVDT Trainer kit,
        Multimeter etc.

THEORY:

      Linear Variable Differential Transformer (LVDT) as the name suggests is a type of transducer which uses the difference of the output of two windings as a resultant output to indicate the unit of parameter to be measured. A typical LVDT is shown in fig.A soft iron core provides the magnetic coupling between a primary coil and two secondary coils, connected in series opposition. When the core is central and both secondaries are identical, the voltage across them is equal in magnitude. However, the output is zero as both the secondary's in series oppositions. As the core moves up or down, the induced voltage of one secondary coil increases while that of the other decreases. The output voltage, which is modulated, is the difference of the two, since secondaries are in opposition. The output is proportional to the displacement of the iron core.

      The device is very sensitive and is linear over a wide range of motion. The input voltage applied to LVDT is limited by the current carrying ability of the primary coil

      . In most applications, LVDT sensitivities are great enough so that very conservative ratings

can be applied. Many commonly used transformers are made to operate on 2KHz frequency at 5 V peak to peak. Higher frequencies provide increased sensitivity. However, in order to maintain linearity, design differences, primary core length may be required for different frequencies: and in general, given LVDT is designed for a specific input frequency. Exciting frequency sometimes referred as carrier frequency limits the dynamic response of a transformer. Transformer sensitivity is usually stated in terms of mV output per volt input per 0.001 in core displacement. It is directly proportional to exciting voltage and output also increases with frequency.

      Of course the output also depends on LVDT design, and in general, the sensitivity will

increases with increased number of turns on the coils. There is a limit, however, determined by the solenoid effect on the core. In many applications this effect must be minimize d; hencedesign of the general purpose LVDT is the result of compromise. Solenoid or axial force exerted by the core is zero when the core is centred and increases linearly with displacement.
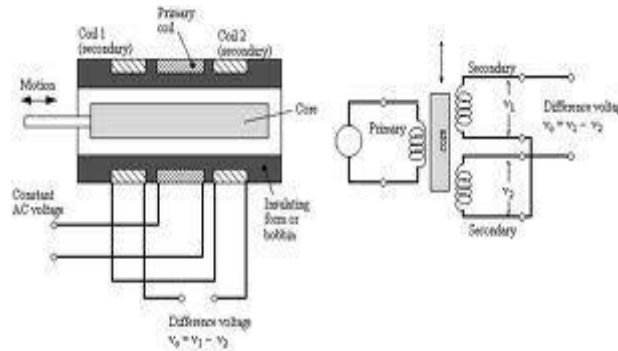
LVDT Principle

GENERAL LVDT ASSEMBLY DESCRIPTION OF HARDWARE:

The Block diagram of the Trainer is shown below for your reference. In the present LVDT Trainer, a frequency of 5KHz is generated with maximum voltage of 2volts as output and is fed to the LVDT. The output of the LVDT is fed to an amplifier and is amplified by a gain of 100 to bring the output voltage level in the order of volts. The offset is adjusted in such a way that the output of the amplifier is zero when the core is in the centre. A micrometre gage is fixed in such a way that the 15mm reading of the micrometre is indicated by zero of the amplifier. The LVDT used here is a spring loaded. When the micrometre is rotated clockwise, the core is moved inside the transformer. The current flowing through the two windings changes and the difference of the two is amplified, rectified and displayed on the digital meter. As the micrometre is moved to a level of 0mm of reading of displacement, the output is maximum.

PROCEDURE:

1) Connect 3Pin power supply chord to mains 230V,50Hz, Keep the sitch in off position before connecting to mains

2) Switch on the system and allow % minutes warmup period

3) Rotate the micrometer (calibration Jig) up to 10mm

4) Calibrated the trainer by adjusting the P1 &P2 POTs nearly to center position to read the displacement

5) Now rotate micrometer by 1mm until 10mm to 0mm in backward direction and see the values

of the displacement counter,as for every two rotations one digit increment(i.e. nearly it reads 10)

6) Now repeat the same procedure for forward direction (i.e.)10mm to 20mm in micrometer

7) Rotate the micrometre to in steps of 1,2,3mm and tabulate the corresponding readings.The display will be corresponding readings i.e Core displacement.

8)Tabulate the readings and plot the graph between display in mm and actual displacement in mm

OBSERVATION TABLE

S.NO	Micrometer Reading(mm)	Indicated Reading(mm)	Error	%Error

PRECAUTIONS:
1)Handle the lab equipments carefully.
2)Reading should be taken carefully
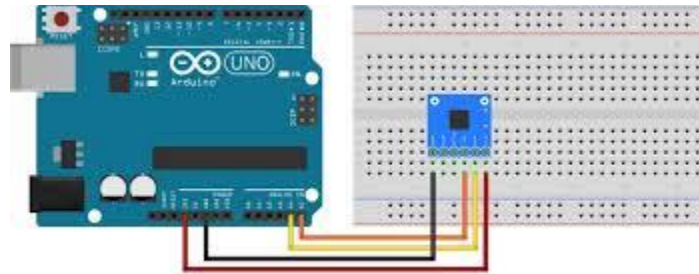3)Proper switch OFF the equipments after using

RESULT:

8. TEMPERATURE, PRESSURE & HUMIDITY DETECTION CIRCUITARY

AIM: To sense the Temperature and Pressure using ARDUINO

APPARATUS:
1) Arduino UNO board
2) GY-65 Sensor

3) Small Bread Board
4) Connecting wires
5) Arduino software

CIRCUIT DIAGRAM:

Circuit connection of GY-65/BMP180/280 with Arduino

THEORY:

The BMP085 is a basic sensor that is designed specifically for measuring barometric pressure (it also does temperature measurement on the side to help). It's one of the few sensors that does this measurement, and its fairly low cost so you'll see it used a lot. You may be wondering why someone would want to measure atmospheric pressure, but its really useful for two things. One is to measure altitude. As we travel from below sea level to a high mountain, the air pressure *decreases*. That means that if we measure the pressure we can determine our altitude - handy when we don't want the expense or size of a GPS unit. Secondly, atmospheric pressure can be used as a predictor of weather which is why weather-casters often talk about "pressure systems" On the way to a small weather station, with the air pressure and temperature measurement and use a breakout board for the BMP085 with an I²C interface, and an Arduino of our choice.

BMP085 Features

BMP085 is low power (5uA) high precision (0.03hPa) pressure sensor for mobile devices and can be connected to variety of microprocessors via I2C bus.

- Pressure range: 300 - 1100hPa (~ altitude 9000 - 500m)
- Supply voltage: VDDA: 1.8V-3.6V, VDDD 1.62V-3.6V

- LCC8 package 5.0mm x 5.0x1.2mm
- Low consumption: 5uA in standard mode
- High accuracy: resolution ratio is 0.06hPa (0.5 meter) in low power mode, 0.03hPa (0.25 meter) in high linear mode
- Temperature output
- I2C interface
- Temperature compensation
- Leadless, RoHS standard
- Response time: 7.5ms
- Standby current: 0.1uA
- Does not need external clock

Applications:

GPS pinpoint navigation (dead reckoning, fluctuation bridge detection)
Indoor and outdoor navigation
Detection for entertainment, sports, health care
Weather forecast
Vertical speed instruction (rise/sink speed)
Fan power control
- Refer Sensor datasheet

```
#include <Wire.h>
#include <Adafruit_BMP085.h>
Adafruit_BMP085 bmp;
  void setup() {
  Serial.begin(9600);
  if (!bmp.begin()) {
      Serial.println("Could not find a valid BMP085 sensor, check wiring!");
      while (1) {}
  }
}
  void loop() {
   Serial.print("Temperature = ");
   Serial.print(bmp.readTemperature());
   Serial.println(" *C");
   Serial.print("Pressure = ");
   Serial.print(bmp.readPressure());
   Serial.println(" Pa");
  Serial.println();
   delay(500);
}
```

BMP180/GY- 65/ BMP280 Temperature and pressure sensor

OBSERVATIONS:
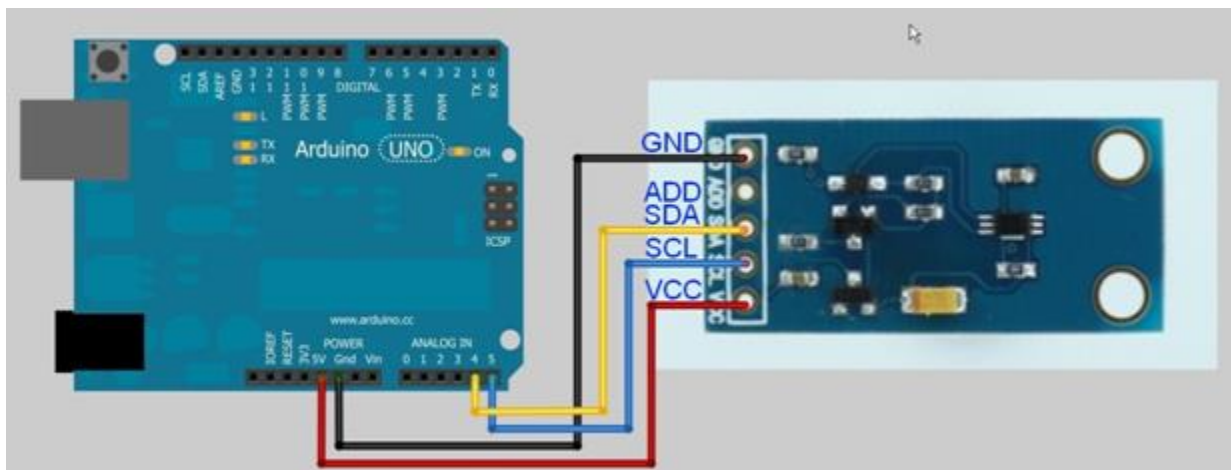**SERIAL MONITOR:**

RESULT:

9. LIGHT SENSOR

AIM: To sense Light intensity using Arduino

APPARATUS:
  1) Arduino UNO board
  2) Current Sensor

  3) Two Resistors 1kΩ each
  6) Small Bread Board
  7) Connecting wires
  8) Arduino software

**CIRCUIT DIAGRAM**:

Circuit connections GY-30 with Arduino

THEORY:
In this simple circuit, we use a small BH1750FVI sensor on a breakout board and an Arduino to measure the illuminance in lux. Besides the application to measure the illumination of objects in the photography, you can – with an extension of this circuit – also easily make an adapted illumination of rooms or gardens. It is also possible to realize an automatic brightness control for displays.

FEATURES:
- Digital Light intensity detection module: GY-30 Chip : BH1750FVI
- Power supply: 3V-5V power
- Light range : 0-65535 lx
- Sensor built-in : 16 bitAD converter
- Direct digital output, bypassing the complex calculation, bypassing the calibration
- Don't distinguish between ambient light
- Close to the spectral characteristics of visual acuity

- widely use to 1-lux high precision measurement
- Standard NXP I2C communication agreement

VCC	3-5v
SCL	I2C clock
SDA	I2C data
ADDR	I2C device address
GND	Ground
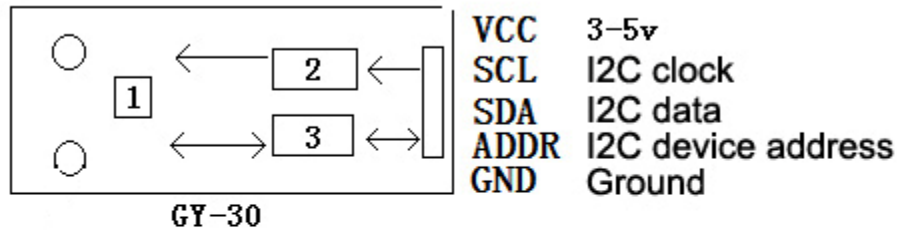
GY-30

1 BH1750FVI

2 Low-power 3.3V regulator (3-5V compatible)

3 Level conversion

- Refer GY-30 Module datasheet
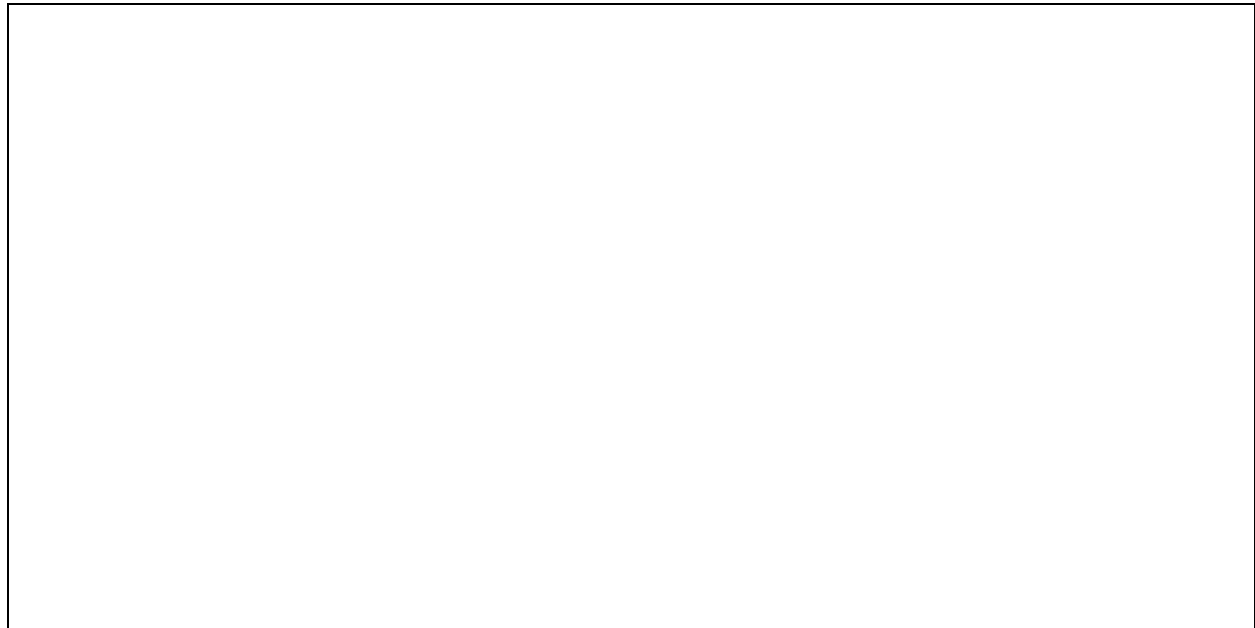

GY-30 Light Sensor

Program:
```
#include <Wire.h>
#include <Wire.h>
int BH1750_address = 0x23; // i2c Addresse
byte buff[2];
void setup(){
  Wire.begin();
  BH1750_Init(BH1750_address);
  delay(200);
  Serial.begin(9600);
  Serial.println("Measurement of illuminance with a BH1750FVI Breakout Board (GY-30) and
an Arduino Uno");
}
void loop(){
  float valf=0;
  if(BH1750_Read(BH1750_address)==2){
```

```
    valf=((buff[0]<<8)|buff[1])/1.2;
    if(valf<0)Serial.print("> 65535");
    else Serial.print((int)valf,DEC);
    Serial.println(" lx");
   }
  delay(1000);
}
void BH1750_Init(int address){
 Wire.beginTransmission(address);
 Wire.write(0x10); // 1 [lux] aufloesung
 Wire.endTransmission();
}
 byte BH1750_Read(int address){
 byte i=0;
 Wire.beginTransmission(address);
 Wire.requestFrom(address, 2);
 while(Wire.available()){
  buff[i] = Wire.read();
  i++;  }
 Wire.endTransmission();
 return i; }
```
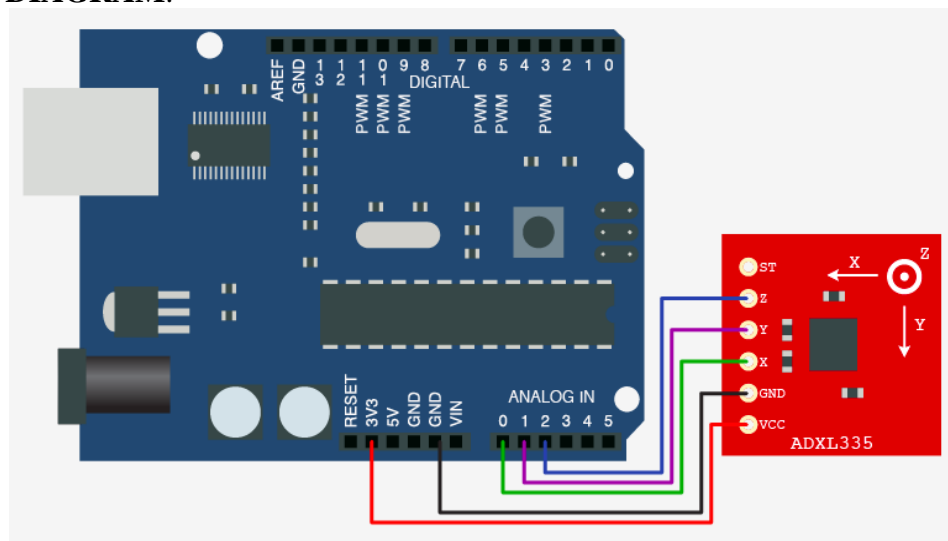
OBSERVATIONS:
SERIAL MONITOR:

RESULT:

10. ACCELEROMETER SENSOR

AIM: To Show how to take an analog 3-axis **accelerometer** and use it to sense simple orientation with it using Arduino

APPARATUS:

        1) Arduino UNO board
        2) ADXL335 3-axis accelerometer
        3) Connecting wires

        4) Arduino software

CIRCUIT DIAGRAM:

Circuit Connections of ADXL335sensor with Arduino

THEORY:

One of the most common inertial sensors is the **accelerometer**, a dynamic sensor capable of a vast range of sensing. Accelerometers are available that can measure acceleration in one, two, or three orthogonal axes. They are typically used in one of three modes:

- As an intertial measurement of velocity and position;
- As a sensor of inclination, tilt, or orientation in 2 or 3 dimensions, as referenced from the acceleration of gravity (1 g = 9.8m/s^2);
- As a vibration or impact (shock) sensor.

There are considerable advantages to using an analog accelerometer as opposed to an inclinometer such as a liquid tilt sensor – inclinometers tend to output binary information (indicating a state of on or off), thus it is only possible to detect when the tilt has exceeded some

thresholding angle. There are several different principles upon which an analog accelerometer can be built. Two very common types utilize capacitive sensing and the piezoelectric effect to sense the displacement of the proof mass proportional to the applied acceleration. Breakout board for the 3 axis ADXL335 from Analog Devices. This is the latest in a long, proven line of analog sensors - the holy grail of accelerometers. The ADXL335 is a triple axis MEMS accelerometer with extremely low noise and power consumption - only 320uA! The sensor has a full sensing range of +/-3g.There is no on-board regulation, provided power should be between 1.8 and 3.6VDC.Board comes fully assembled and tested with external components installed. The included 0.1uF capacitors set the bandwidth of each axis to 50Hz.

- Refer ADXL335 Datasheet

ADXL335 3-axis Accelerometer sensor

Program:

```
void setup()

{

  Serial.begin(9600);     // sets the serial port to 9600

}

void loop()

{

  x = analogRead(0);      // read analog input pin 0
```

```
y = analogRead(1);      // read analog input pin 1

z = analogRead(2);      // read analog input pin 1

Serial.print("accelerations are x, y, z: ");

Serial.print(x, DEC);   // print the acceleration in the X axis

Serial.print(" ");      // prints a space between the numbers

Serial.print(y, DEC);   // print the acceleration in the Y axis

Serial.print(" ");      // prints a space between the numbers

Serial.println(z, DEC); // print the acceleration in the Z axis

delay(100);             // wait 100ms for next reading
}
```

OBSERVATIONS:

SERIAL MONITOR:

RESULT:

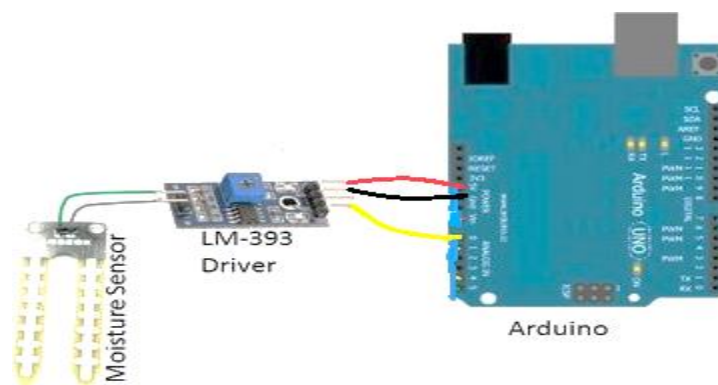# 11.   RAIN FALL & SOIL MOISTURE DETECTION CIRCUITRY

AIM: To detect the Rainfall & Moisture Content using Arduino

APPARATUS:

        1) Arduino UNO board

        2) Soil moisture sensor

        3) LM393 Driver

        4) Connecting wires

        5) Arduino software

        6) Rainfall Sensor

SOIL MOISTURE SENSOR:

Circuit diagram:

Circuit Connections of Soil Moisture sensor with Arduino

THEORY:

Soil moisture sensor measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. The Soil Moisture Sensor uses capacitance to measure the water content of soil (by measuring the dielectric permittivity of the soil, which is a function of the water content). Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent.

Features:

1).This is a simple water sensor ,can be used to detect soil moisture .Module Output is high level when the soil moisture deficit,or output is low.Can be used in module plant waterer device, and the plants in your garden no need people to manage.

2).Adjustable sensitivity by adjusting the digital potentiometer (shown in blue)

3).Operating voltage:3.3V~5V

4).Dual output mode,analog output more accurate.

5).A fixed bolt hole for easy installation

6).Panel PCB Dimension: 30mm * 16mm

7).Soil Probe Dimension:60mm*30mm

8).With power indicator (red) and digital switching output indicator (green)
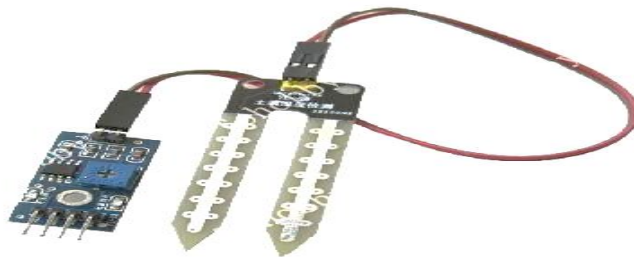
9).Having LM393 comparator chip, stable

Pin definition
VCC   5V

GND   GND

DO   Digital output interface (0 and 1)

AO   Analog output interface

Soil Moisture sensor

Program:
```
void setup ()

{
// initialize serial communication at 9600 bits per second:
Serial. begin (9600);
}
void loop() {
// read the input on analog pin 0:
int sensorValue = analogRead(A0);

Serial.println(sensorValue);
delay (2000);
}
```

OBSERVATIONS:

SERIAL MONITOR:

RESULT:

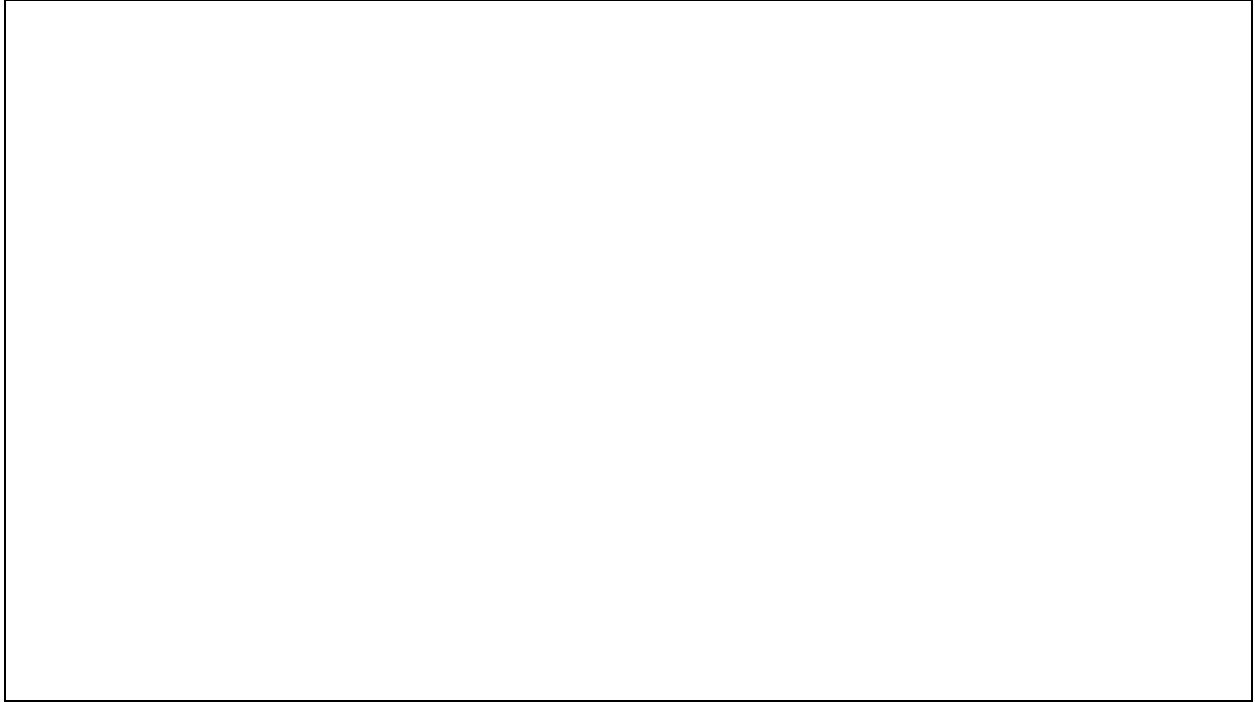**RAINFALL SENSOR:**

Rainfall sensor

Circuit Diagram

THEORY

Program :

Program :

OBSERVATIONS:

SERIAL MONITOR:
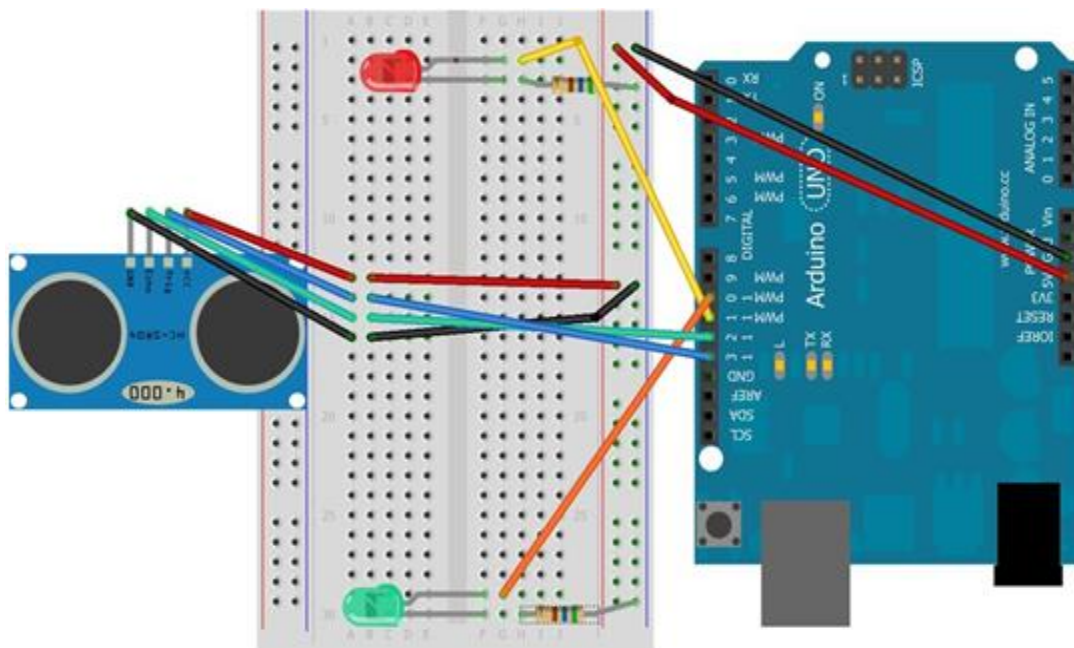
RESULT:

12.   DISTANCE SENSOR

AIM: To display the distance the object is placed from the sensor using Arduino

APPARATUS: 1) Arduino UNO board
        2) Ultrasonic Sensor HCSR04

        3) LCD

        4) Two Resistors 100Ω each

        5) Two LEDs
        6) Small Bread Board
        7) Connecting wires
        8) Arduino software

Circuit diagram:

Circuit Connections of Ultrasonic sensor with Arduino

Theory:

ULTRASONIC SENSOR:

      Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes

from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor.

HCSR04 Module

Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure the amount of liquid in a tank, the sensor measures the distance to the surface of the fluid.

Program:

```
#include<LiquidCrystal.h>

LiquidCrystallcd(8,9,4,5,6,7);

#define led 11

#define led2 10

int p = 13; // initializing p as 13.

int i = 12;

long microseconds;

void setup()
{
pinMode(p, OUTPUT);  //initializing p as output pin.

pinMode(i, INPUT);
```

```
pinMode(led, OUTPUT);  //initializing LED as output pin.

pinMode(led2, OUTPUT);

lcd.begin(16,2);

Serial.begin(9600); //giving baud rate as 9600.
}

void loop()
{

  long duration, inches, cm;

digitalWrite(p, LOW);

delayMicroseconds(2);

digitalWrite(p, HIGH);

delayMicroseconds(10);

digitalWrite(p, LOW);

delayMicroseconds(2);

  duration = pulseIn(i, HIGH);

  inches = microsecondsToInches(duration);

  cm = microsecondsToCentimeters(duration);

  if (cm < 10)
  {  // This is where the LED On/Off happens

digitalWrite(led,HIGH); // When the Red condition is met, the Green LED should turn off

digitalWrite(led2,LOW);
  }
  else

  {

digitalWrite(led,LOW);
```

```
digitalWrite(led2,HIGH);

}

lcd.print("DISTANCE=");

lcd.setCursor(0,1);

lcd.print(inches);

lcd.print("in, ");

lcd.print(cm);

lcd.print("cm");

Serial.print(inches);

Serial.print("in, ");

Serial.print(cm);

Serial.print("cm");

Serial.println();

  delay(1000);

lcd.clear();

 }

 long microsecondsToInches(long microseconds)

{
 // According to Parallax's datasheet for the PING))), there are

 // 73.746 microseconds per inch (i.e. sound travels at 1130 feet per

 // second).  This gives the distance travelled by the ping, outbound

 // and return, so we divide by 2 to get the distance of the obstacle.

 return microseconds / 74 / 2;

}
```
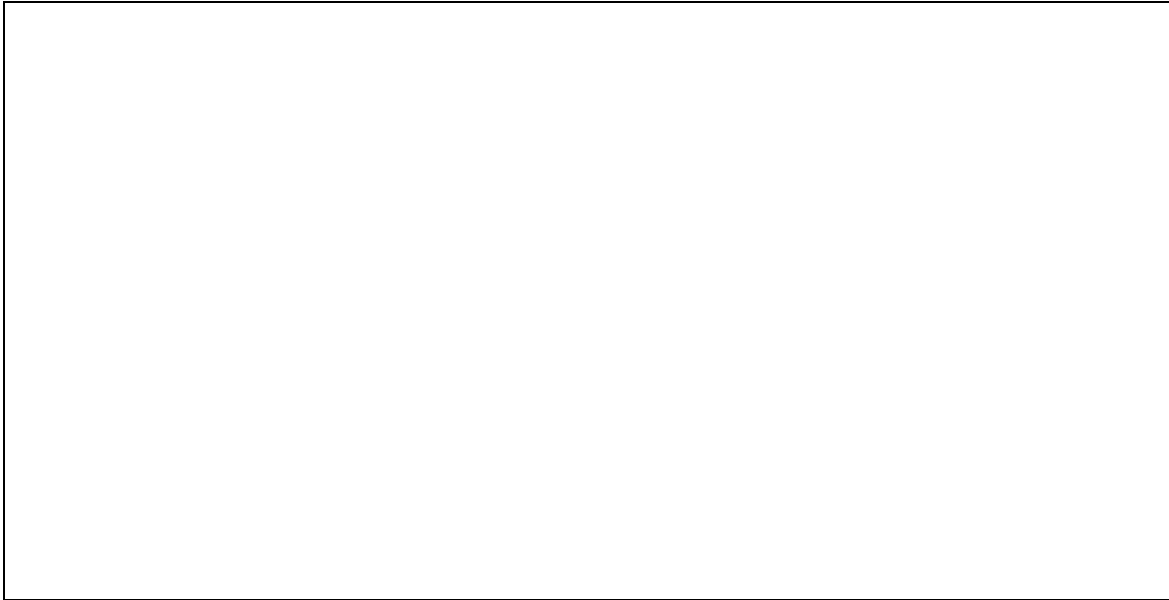
```
long microsecondsToCentimeters(long microseconds)

{

  return microseconds / 29 / 2;

}
```

OBSERVATIONS:
SERIAL MONITOR:

RESULT:

Vision of the Department

The Vision of Electrical and Electronics Engineering Department is to become a nationally and internationally leading institution of higher learning, building upon the culture and values of universal science and contemporary education, and a center of research and education generating the knowledge and the technologies which lay the groundwork in shaping the future in Electrical and Electronics Engineering.

Mission of the Department

To become an internationally leading department for higher learning.

To build upon the culture and values of universal science and contemporary education.

To be a center of research and education generating knowledge and technologies which lay groundwork in shaping the future in the fields of electrical and electronics engineering.

To develop partnership with industrial, R&D and government agencies and actively participate in conferences, technical and community activities.

Program Educational Objectives

This education is meant to prepare our students to thrive and to lead. In their careers, our graduates:

1. Will have successful technical or professional careers, including supportive and leadership roles on multidisciplinary teams.
2. Will acquire, use and develop skills required for effective professional practices.
3. Will acquire the holistic education necessary to be a responsible member of society.
4. Engage in life-long learning to remain current in their profession and be leaders in our technological society.

Programme Learning Outcomes:

Students in the Electrical and Electronics Engineering program should, at the time of their graduation, be in possession of:

A. Ability to apply knowledge of mathematics, science, and engineering.
b. Ability to design and conduct experiments, as well as to analyze and interpret data.
c. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
d. Ability to function on multi-disciplinary teams.
e. Ability to identify, formulate, and solve engineering problems.
f. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
h. Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
i. Recognition of the need for, and an ability to engage in life-long learning.
J. Knowledge of contemporary issues.
k. Ability to utilize experimental, statistical and computational methods and tools necessary for engineering practice.
l. Graduates will demonstrate an ability to design electrical and electronic circuits, power electronics, power systems, electrical machines analyze and interpret data and also an ability to design digital and analog systems and programming them.

PSO 1 : Graduates will interpret data and able to analyze digital and analog systems related to electrical and programming them.

PSO 2 : Graduates will able to demonstrate, design and model electrical, electronic circuits, power electronics, power systems and electrical machines

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