MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

Department of Electrical Electronics & Communication Engineering

COURSE NO: EECE- 314

(Electrical Measurement , Instrumentation and Sensors Lab)

OPEN ENDED LAB

Group 03

NAME OF THE EXPERIMENT: AC ENERGY METER USING HALL EFFECT AND ARDUINO.

OBJECTIVE:

1. To measure AC current and voltage

2. To facilitate effective energy management and promote sustainable practice.

3. To design a cost efficient alternative of a typical energy meter.

THEORY:

An energy meter is a device used to measure the amount of electrical energy consumed by an AC circuit. It measures both the voltage across the load and the current flowing through it.The integration of the Hall effect and Arduino in energy metering has been a relatively recent development with significant progress made in the last decade. The Hall effect is a physical phenomenon where a voltage is generated across the conductor when it is placed in a magnetic

field perpendicular to the magnetic field strength and current. The hall effect sensor operates based on the principle that a magnetic field can induce a voltage across a conductor.

Hall effect voltage expressed as:

$$V_H = BI / (n \times e \times t)$$

Where,

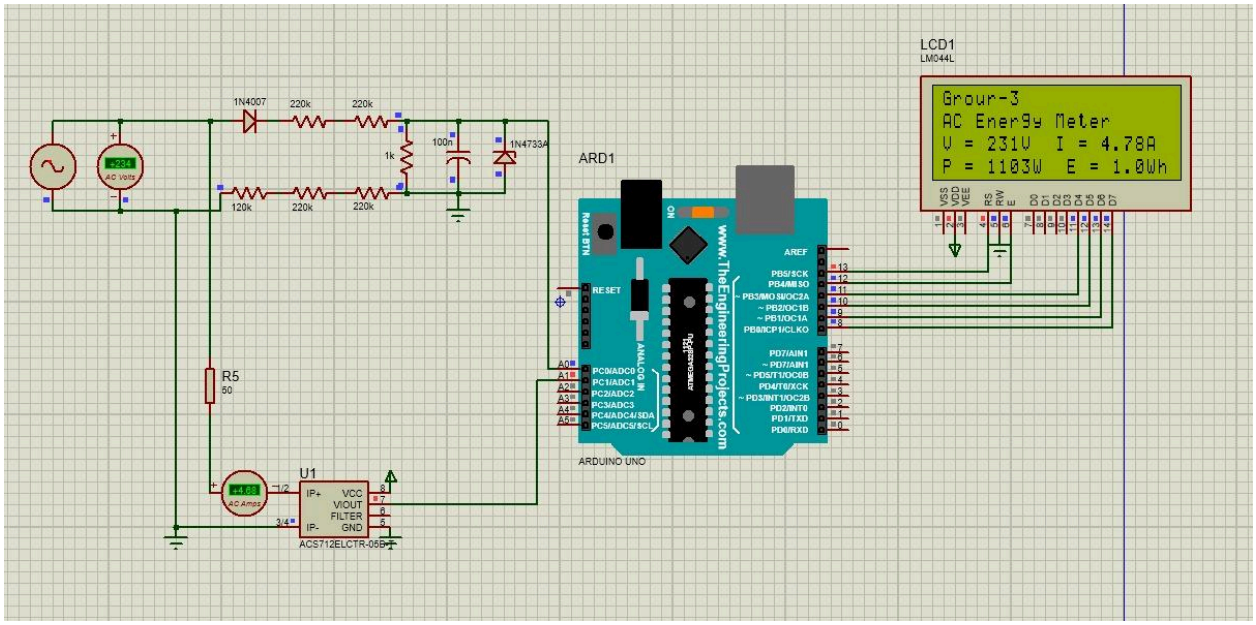
B = Magnetic field strength
I = Current through the conductor
n = Charge carrier density
t = Thickness of the conductor

Arduino has the ability to measure AC current via hall effect by analog input pins.Arduino microcontrollers,like the ATmega328P found in the Arduino uno, features built in analog to digital converters(ADC) on certain analog input pins.The Arduino's ADC has a 10-bit resolution, meaning it can be distinguish 1024 different levels. For a 10-bit ADC,binary range is from 0 to 1023,corresponding to the input voltage range. The analog signal is sampled at discrete intervals during conversion. The frequency at which the analog is sampled is determined by the ADC clock speed. For an ATMEGA328P microcontroller, the ADC operates at a default clock speed of 125kHz with a 13 cycle conversion time, the conversion rate is approximately 9600 samples per second.

$$\text{ADC value} = (\text{input} / \text{voltage}_{ref}) * 1023$$

An ADC involves several key stages in its operation like sampling, quantization, encoding, output. Those stages work together to convert analog signals into a digital format suitable for electronics processing. The experiment successfully demonstrates the use of a hall effect sensor with an Arduino to measure AC energy. Further improvements could involve better noise filtering and incorporation of additional sensors for more comprehensive monitoring.

CIRCUIT DIAGRAM



APPARATUS

Name of Apparatus	Number of Apparatus
Zener Diode	01
Diode	01
Capacitor	01 (100nF)
Resistors	05 (220k & 120k)
ACS712	01
Arduino Uno	01
LCD Display	01
AC Voltmeter	01
AC Ammeter	01

PROCEDURE

1. Connect the circuit according to the diagram.
2. Upload the arduino code. Use Arduino ADC conversion formula.
3. Calibrate arduino for a specific input . Change the calibration for more accurate data.
4. Compare the output with a voltmeter and ammeter.
5. Record readings for current and voltage at regular intervals.Take 20 data samples.
6. calculate error percentage both in voltage and current.
7. Repeat this procedure in simulation

DATA TABLE

INPUT PK	VOLTMETER I/P	ARDUINO VOLTAGE O/P	CURRENT I/P	ARDUINO CURRENT O/P

REPORT QUESTION

1. Draw voltage vs input pk graph.
2. Draw current vs input pk graph.
3. Write down comparison between regular energy meter and Arduino based AC energy meter.
4. Write down advantages and disadvantages of this AC energy meter .