CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
CHITTAGONG-4349, BANGLADESH.

Course No. EEE-182

Course Title: Basic Electrical Engineering Sessional

Experiment No. 1

FAMILIARIZATION WITH MEASURING INSTRUMENTS AND VERIFICATION OF OHM'S LAW

PRELAB WORK:

- **Read this laboratory manual carefully before coming to the laboratory class, so that you know what is required.**
- Try to **follow** the lecture notes of **EEE 111.**
- **DONOT** copy others blindly!!!
- **Submit your lab report before the roll call.**

OBJECTIVE:

a) The objective of this experiment is to get familiar with the measuring instruments Ammeter, Voltmeter and Wattmeter.

b) To verify the Ω's law experimentally.

FOR OBJECTIVE-(a)

APPARATUS:

1. Ammeter
2. Voltmeter
3. Wattmeter
4. Rheostat etc.

THEORY:

Current and potential differences are most often determined by reading them directly from the scales of indicating instruments known, as ammeters and voltmeters. The basic principle of the ammeter and of the voltmeter is the same. The moving element is actuated by current in either case. In the ammeter, the element is actuated by the current we wish to measure, or a certain fraction of that current. In the voltmeter, the moving element is actuated by a current, which is proportional to the potential difference we wish to measure, since the current through the instrument is

$$I_V = V/R$$

Ammeter: The ammeter, since it measures current, is connected in series with the circuit under test. Because there is only one current path in a series circuit, all of the circuit current flows through the meter. However, the ammeter must introduce minimum additional resistance into the circuit.

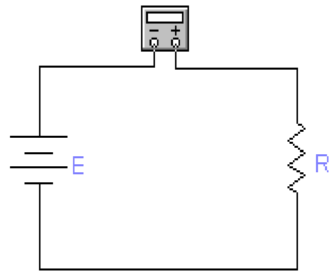

Figure 1: Ammeter Connection

Current flow in a series circuit varies with the total resistance of the circuit so, if the total resistance is increased, circuit current will decrease and the ammeter will not indicate the true circuit current value. Of course, an ammeter will always add some series resistance to a circuit but the objective of good meter design is to disturb the circuit being measured as little as possible. Therefore, the ammeter resistance should be very low, preferably zero. To extend the range of the ammeter, we must place resistance in parallel or shunt with the meter, creating a current path around the meter for the excess current.

<u>Voltmeter:</u> The dc voltmeter enables us to measure any value of dc voltage between two points in an electric circuit within the capability of the meter. It is thus in parallel with the circuit or some part of the circuit. To be used in this way, a voltmeter must have enough resistance so that it will not be injured by the current that flows through it, and so that it will not materially affect the current in the circuit to which it is connected. The dc voltmeter has a basic meter movement, commonly called a moving coil or *D Arsenoval* type movement, and one or more series resistors known as multiplier resistors. As the name implies, multiplier resistors increase, or multiply the range of the basic meter movement.

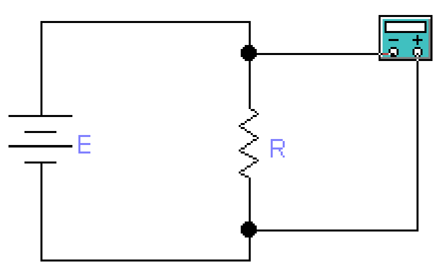

Figure 2: Voltmeter Connection

The moving coil meter requires a certain current passing through the coil to deflect the pointer to full scale. The full-scale current may be anywhere from a few microamperes to several mill amperes. If the meter requires very little current to give full-scale deflection, the sensitivity of the meter is said to be high. Two factors, the full-scale deflection current and the resistance of the moving coil, must be known before a multiplier resistor can be added in series with the meter movement to increase the range.

<u>Wattmeter:</u> This instrument is similar in design and construction to electrodynamometer type ammeters and voltmeters. The two coils are connected to different circuits for measurement of power. The fixed coils or 'field coils' are connected in series with the load and so carry the current in the circuit. The fixed coil therefore forms the current coil or simply c.c. of the wattmeter.

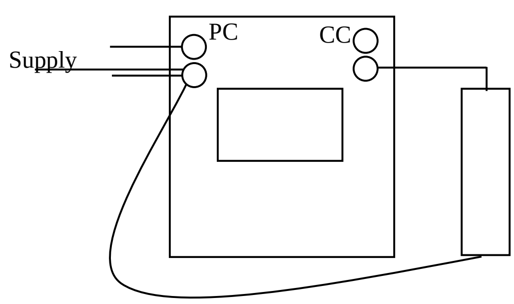

Fig.c: Wattmeter Connection

The moving coil is connected across the voltage and therefore carries a current proportional to the voltage. A high non-inductive resistance is connected in series with the moving coil to limit the current to a small value. Since the moving coil carries a current proportional to the voltage, it is called the 'pressure coil' or 'voltage coil' or simply called p.c. of the wattmeter.

CIRCUIT DIAGRAM:

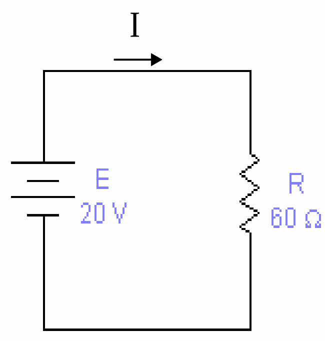

Figure 1: Series circuit

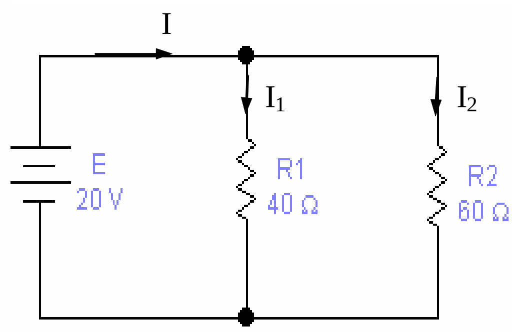

Figure 2: Parallel circuit

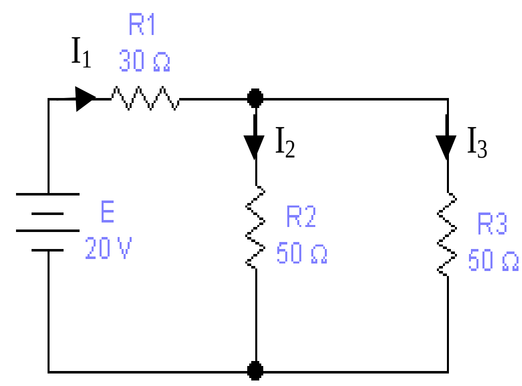

Figure 3: Series-Parallel circuit

PROCEDURE:

1. Connect the circuit as shown in Fig. 1.
2. Measure voltage drop, current, and power consumption across each resister
3. Repeat the process for Fig. 2 and Fig. 3.

REPORT:

1. Compare the measured value with calculated value. If there is any difference briefly discuss, why?
2. Can we measure only voltage or current by wattmeter? How?

FOR OBJECTIVE-(b)

THEORY:

The relationship among voltage, resistance and current is summarized in a statement called Ω's law. Ω discovered that the amount of current in a circuit is directly proportional to the voltage established across the circuit and inversely proportional to the resistance of the circuit. In mathematical form this relationship can be expressed as:

$$Current = \frac{Voltage}{Resistance}$$

Or,

$$I = \frac{V}{R}$$

where, V = Potential difference, in volts,

I = Current, in amperes,

R = Resistance, in Ωs.

In this experiment you will determine the resistance of a known and an unknown resistor through voltage and current measurements.

APPARATUS:

1. 44Ω rheostat.
2. DC voltmeter.
3. DC milli-ammeter.
4. 40Ω resistor.
5. Unknown resistor.
6. Connecting wire.

CIRCUIT DIAGRAM:

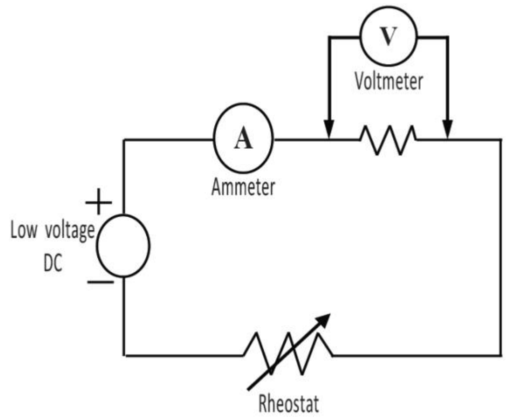

Figure 1: Circuit arrangement for the verification of Ohm's Law.

PROCEDURE:
Part-a

1. Connect a 40Ω resistor and the electrical components in a series circuit, as shown in Fig. 1. The voltmeter is connected across (in parallel with) the 40Ω resistor.
2. Have the instructor check the circuit when you have everything connected. He or she will connect the circuit to a low-voltage power supply and make sure the circuit is connected properly before you proceed.
3. Adjust the rheostat at different settings and obtain at least six different values for the current and voltage. Begin by setting the rheostat at the position that measures the smallest current in the circuit. Afterwards move the rheostat at approximately equal intervals and records each measurement in Table 1.

Part-a

4. Disconnect the circuit from the power supply. Remove the 40Ω resistor and replace with an unknown resistor. Have the instructor check the circuit again before proceeding.
5. After the instructor reconnects the circuit to the power supply, repeat step 3 above with the unknown resistor. Record data in Table 2.

EXPERIMENTAL DATA:

Table-1(With 40Ω resistor)

Rheostat setting	1	2	3	4	5
Voltage in volts					
Current in amps					

Table-2(With unknown resistor)

Rheostat setting	1	2	3	4	5
Voltage in volts					
Current in amps					

CALCULATION:

1. Graph data in Table 1 as current (x-axis) vs. voltage (y-axis), and determine the slope of the resulting line. Shown calculations below.

Slope = ___________________________________

2. Graph data in Table 2 as current (x-axis) vs. voltage (y-axis), and determine the slope of the resulting line. Shown calculations below.

Slope = ___________________________________

REPORT:

1. Show the results in tabular form.

2. Comment on the results obtained and discrepancies (if any).

CAUTION:

1. Do not switch on the supply until the circuit has been checked by your teacher.
2. Take care of the apparatus.
3. Do not touch any open ended wire or cable with applying voltage supply at the other end.

HOME TASK:

Answer the following questions –

Investigate the properties of each circuit provided in the lab, and answer the following questions:

1. What change do you observe in the brightness of the lamps in a series circuit as more lamps are added to the circuit? Give an explanation for your observation.

2. What change do you observe in the brightness of the lamps in a parallel circuit as more lamps are added to the circuit? Give an explanation for your observation.

3. What happens in a series circuit as one of the lamps is disconnected?

4. What happens in a parallel circuit as one of the lamps is disconnected?

5. A voltmeter reads 80 volts when connected in parallel with an unknown resistor that has 0.125 amperes flowing through it. What is the resistance of the unknown resistor? Show all your calculations below.