Department of Electrical Engineering
Assignment
Date: 20/04/2020

Course Details

Course Title: Instrumentation and Measurement **Module:** 6th (BE)
Instructor: **Total Marks:** 30

Student Details

Name: Muhammad Kamran **Student ID:** 13752

Q1.	**(a)**	A student mistakenly connects an ammeter in parallel in a circuit. What will happen? Explain briefly.	**Marks 05** **CLO 2**
	(b)	A student mistakenly connects a voltmeter in series in a circuit. What will happen? Explain briefly.	**Marks 05** **CLO 2**
Q2.	**(a)**	Random error cannot be easily reduced in measurements. Justify this statement.	**Marks 05** **CLO 1**
	(b)	What are the different reasons due to which gross error occurs in measurement? Explain briefly.	**Marks 05** **CLO 1**
Q3.	**(a)**	What will happen if a spring in not connected with the coil of a moving coil galvanometer? Explain briefly.	**Marks 05** **CLO 2**
	(b)	A student is performing an experiment in the laboratory during which he finds out that the measuring instrument is giving a Full Scale Deflection for a current of 10 μ A. He wants to measure a voltage of 20V with the help of this measuring instrument. Now, What should be the appropriate value of the resistor to be added with this instrument so that it can measure up to 20V? Moreover, should the resistor be connected in series or parallel with this instrument?	**Marks 05** **CLO 02**

NAME: MUHAMMAD KAMRAN

ID # : 13752

SUBJECT: INSTRUMENTATION AND MEASUREMENT

INSTRUCTOR: ENGR.WALEED JAN

Q#1 (a): A student mistakenly connects an ammeter in parallel in a circuit. What will happen? Explain briefly.

Ammeter:

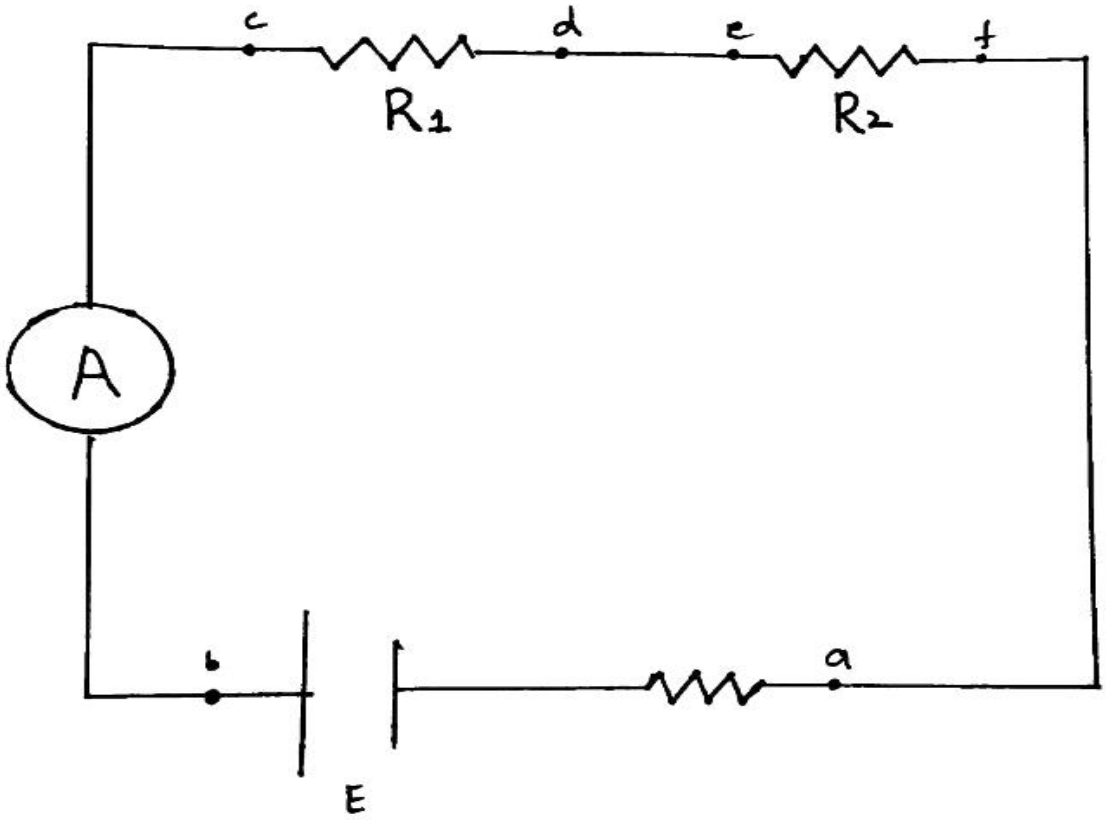
An Ammeter is a meter to measure current flow in a circuit. To do that you must connect it where all the current flows through the meter. It is made by using a very low value resistor (as low as possible, maybe 0.1 Ohm) in series with the circuit so that it affects the circuit conditions as little as possible. The meter actually measures the voltage across the very low value resistor but the scale is in amps. Ohms law states that the Voltage across a resistor is proportional to the current flowing.

Why ammeter connected in series?:

Ammeter is either connected in series to the line along which the flow of current is measured or connected across the CT/ shunt resistor (if the current is high). The loss cause in the circuit due to the connection of ammeter in series is known as burden of the ammeter.

The flow of current is always along the length of the conductor. The purpose of using ammeter is to measure the rate of current flowing through it. Hence, to make the measurement possible, the whole current has to flow through the coil of the ammeter. This is why ammeter is connected in series. The ammeter coil is designed to offer very less resistance to the flow of current. Hence the voltage drop across the ammeter is negligible.

Circuit diagram:



What happened when we connect ammeter in parallel?

An ideal ammeter has zero resistance on the other hand a non-ideal ammeter has very small resistance. When we connect an ammeter in parallel, as we know that current always follows low resistance path, maximum amount of current will flow through the ammeter which in turn will burn the fuse or can damage the ammeter. Therefore in electrical engineering labs, important precautions while connecting the circuits are, connect the ammeter in series and voltmeter in parallel.

Q#1 (b): A student mistakenly connects a voltmeter in series in a circuit. What will happen? Explain briefly

Voltmeter:

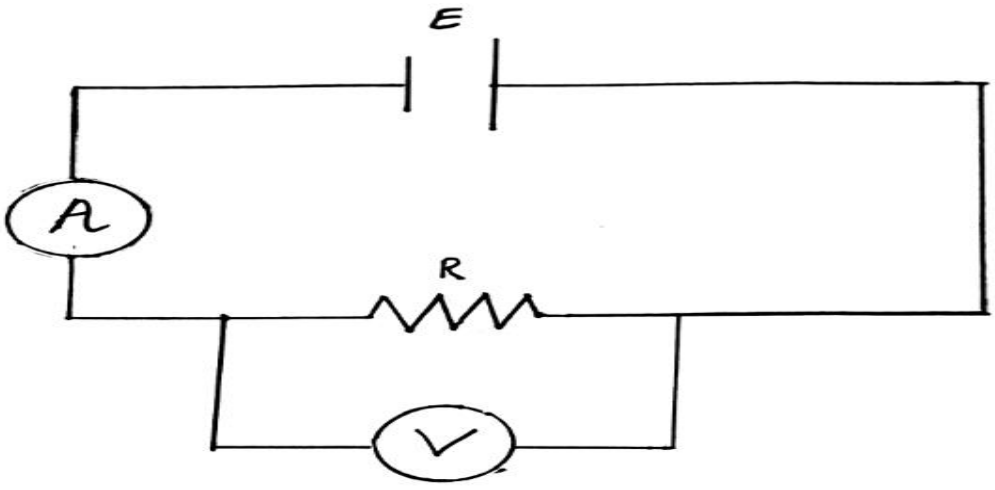
A voltmeter is an instrument used for measuring electrical potential difference between two points in an electric circuit. Analog voltmeters move a pointer across a scale in proportion to the voltage of the circuit; digital voltmeters give a numerical display of voltage by use of an analog to digital converter.

General purpose analog voltmeters may have an accuracy of a few percent of full scale, and are used with voltages from a fraction of a volt to several thousand volts. Digital meters can be made with high accuracy, typically better than 1%. Specially calibrated test instruments have higher accuracies, with laboratory instruments capable of measuring to accuracies of a few parts per million. Meters using amplifiers can measure tiny voltages of microvolts or less.

Why voltmeter is connected in parallel?

A voltmeter measures the potential difference across two points in a circuit. In parallel connection the voltage in the branches remains same and the resistance of the voltmeter is very high so very less amount of current flows through it and thus it doesn't disturbs the original circuit.

Circuit Diagram:



What happened if we connect voltmeter in series?

Voltmeter has very high resistance to ensure that it's connection do not alter flow of current in the circuit. Now if it is connected in series then no current will be there in the circuit due to its high resistance. Hence it is connected in parallel to the load across which potential difference is to be measured.

Q#2 (a): Random error cannot be easily reduced in measurements. Justify this statement.

Random error:

Random, or chance, errors are errors that are a combination of results both higher and lower than the desired measurement.

Why random error cannot be reduced easily?:

Because a random error makes the measured value both smaller *and* larger than the true value; they are errors of precision. Chance alone determines if the value is smaller or larger. Reading the scales of a balance, graduated cylinder, thermometer, etc. produces random errors. In other words, you can weigh a dish on a balance and get a different answer each time simply due to random errors. They cannot be avoided; they are part of the measuring process. Uncertainties are measures of random errors. These are errors incurred as a result of making measurements on imperfect tools which can only have certain degree of precision.

Random error is due to factors which we cannot (or do not) control. It may be too expensive, or we may be too ignorant of these factors to control them each time we measure. It may even be that whatever we are trying to measure is changing in time or is fundamentally probabilistic. Random error often occurs when instruments are pushed to their limits.

Example:

It is common for digital balances to exhibit random error in their least significant digit. Three measurements of a single object might read something like 0.9111g, 0.9110g, and 0.9112g.

Q#2 (b): What are the different reasons due to which gross error occurs in measurement? Explain briefly.

Gross error:

Gross error basically takes into account human oversight and other mistakes while reading, recording and the readings. The most common of errors, the human error in the measurement fall under this category of errors in measurement .For examples consider the person using the instruments takes the wrong reading, or they can record the incorrect data. Such type of error comes under the gross error. The gross error can only be avoided by taking the reading carefully. Such type of error is very common in the measurement. The complete elimination of such type of error is not possible. Some of the gross errors easily detected by the experimenter but some of them are difficult to find.

For example: The experimenter reads the 31.5ºC reading while the actual reading is 21.5Cº. This happens because of the oversights. The experimenter takes the wrong reading and because of which the error occurs in the measurement

How gross error can be avoided:

Gross errors can be avoided by using two suitable measures and they are written below:

- A proper care should be taken in reading, recording the data. Also, calculation of error should be done accurately.
- By increasing the number of experimenters we can reduce the gross errors. If each experimenter takes different reading at different points, then by taking average of more readings we can reduce the gross errors

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Q#3(a): What will happen if a spring in not connected with the coil of a moving coil galvanometer? Explain briefly.

Galvanometer: A galvanometer is a type of sensitive ammeter; an instrument for detecting small electric current. It is an analog electromechanical actuator that produces a rotary deflection of some type of pointer in response to electric current through its coil in a magnetic field.

Galvanometer coil working:

When a galvanometer is connected to a current carrying circuit, a current flows in the coil of the galvanometer. Since the coil is suspended in a magnetic field, a deflecting torque acts upon it. Due to this torque, coil starts rotating from its position.

As the coil rotates, the controlling springs are twisted and an elastic restoring torque is developed in them and it opposes the rotation of the coil. This torque is proportional to the angle of rotation of the coil.

When the restoring torque (i.e. controlling torque) becomes equal to the deflecting torque, the coil rests in equilibrium position.

What happened if spring not connected to galvanometer coil?

When we give supply to the galvanometer coil so due to magnetic field the galvanometer coil produced deflecting torque and the spring present at another end of the coil produced restoring torque.

That restoring torque is required to bring the galvanometer pointer back to its original position after removal of supply.

If spring not connected to galvanometer coil only deflecting torque will produced and due to absence of restoring torque the pointer of the galvanometer will not come to its starting position after removal of supply.

Q#3(b):

A student is performing an experiment in the laboratory during which he finds out that the measuring instrument is giving a Full Scale Deflection for a current of 10 μ A. He wants to measure a voltage of 20V with the help of this measuring instrument. Now, what should be the appropriate value of the resistor to be added with this instrument so that it can measure up to 20V? Moreover, should the resistor be connected in series or parallel with this instrument?

Data:

$I_g = 10\mu A$

voltag = 20V

G_1(negligible) = 0Ω

Required:

R = ?

Should the resister be connected in series or parallel with this instrument?

Solution:

Method#1 we Know that

$$V = I_g(R + G_1)$$

$$\frac{V}{I_g} = R + G_1$$

$$R = \frac{V}{I_g} - G_1$$

$$R = \frac{V}{I_g} - G_1$$

putting the values

$$R = \frac{20}{10 \times 10^{-6}} - 0$$

$$R = \frac{2}{10^{-6}}$$

$$R = 2 \times 10^{6}$$

$$\boxed{R = 2\ M\Omega}$$ Ans

Resister will connect in series with the instrument because for voltmeter we need high resistance.

Method #2:

$$V = IR$$

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

$$R = \frac{20}{10 \times 10^{-6}}$$

$$R = \frac{2}{10^{-6}}$$

$$R = 2 \times 10^{6}\ \Omega$$

$$\boxed{R = 2\ M\Omega}$$ Ans