<u>Electric Circuit Analysis I</u> <u>EEE-121</u>

Lab 5

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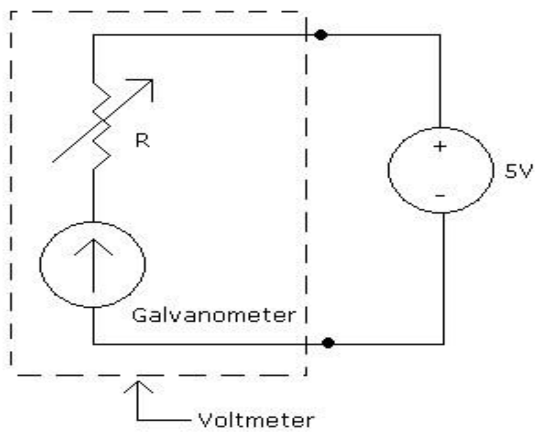
Lab 05: Voltmeter and Ammeter Design Using Galvanometer

Part (a)

A) Voltmeter Design Using Galvanometer
B) Determine The Internal Resistance of a Voltage Source

Pre-Lab

PART A: VOLTMETER DESIGN



Voltmeter design using galvanometer

Measurement of the internal resistance of Galvanometer:

Vg(V)	Ig(A)	Rm meas.(Ω)	Rm calc.(Ω)	R meas.(Ω)	R calc.(Ω)
$32*10^{-3}$	$0.300*10^{-3}$	105.5	106.67	16810	16827

Table Data collection to measure the internal resistance of galvanometer

Part B: Determine the Internal Resistance of a Voltage Source

$$v_l = \left(R_v + R_l\right) i_l \qquad (5.5)$$

This equation can be solved for internal resistance:

$$R_v = \frac{v_l}{i_l} - R_l \qquad (5.6)$$

Where v_l is the voltage and i_l is the current associated with the load resistance R_l.

In Lab

Task (1): Testing the designed voltmeter

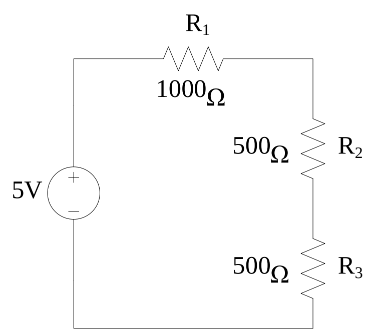


Figure: Test circuit to validate the voltmeter design

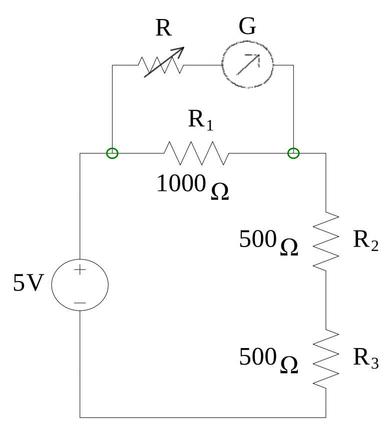


Figure 4: Measuring voltage across the resistor R1

Measurement Table 1:

Value of resistance (Ω)	V measured by the designed voltmeter (V)	V measured by the DMM (V)	% difference
R1 = 989	**2.244**	**2.382**	**5.79**
R2 = 557	**1.245**	**1.342**	**7.23**
R3 = 563	**1.270**	**1.356**	**6.34**

Table

Task (2): Measuring internal resistance of voltage source

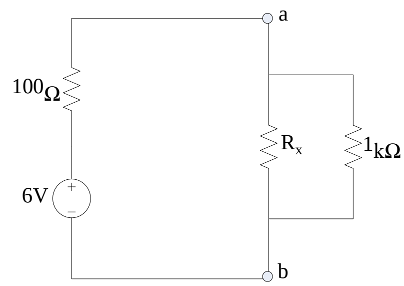


Figure: Test circuit to find the internal resistance of a voltage source

Measurement Table:

Value of the test resistance R_x (Ω)	**Measured value of the current through R_x, i_x (A)**	**Measured value of the voltage across R_x, v_x(V)**
0 (short circuit)	**0.0580**	**0**
100	**0.0270**	**2.883**
220	**0.0172**	**3.850**
470	**0.00970**	**4.57**
1k	**0.00503**	**5.02**
3.3k	**0.00161**	**5.33**
4.7k	**0.00109**	**5.37**
10M	**0.00000**	**5.48**
∞ (open circuit)	**0.0580**	**5.46**

Table

Post Lab

Questions:

1. What do you mean by short and open circuit? What are the values of voltages and currents in open and short circuits?
   Ans: A short circuit is an electrical circuit that allows a current to travel along an unintended path with no or very low electrical impedance. The opposite of a short circuit is an "open circuit", which is an infinite resistance between two nodes.

Current passing through an open circuit is zero, while current through the short circuit is infinite. An open circuit posse's infinite resistance, while a short circuit posses zero resistance. The voltage through the short circuit is zero, while voltage through the short circuit in maximum.

2. Why high resistance is a desirable attribute of voltmeter?

Ans: Voltmeter has high resistance because it measures the voltage difference between two different points, but it should not change the amount of current going through the element between those two points. So, it should have high resistance.

3. What is the basic motivation behind converting galvanometer into ammeter?

Ans: Since Galvanometer is a very sensitive instrument therefore it can't measure heavy currents. In order to measure heavy current, we should convert galvanometer into ammeter so I can measure large currents. convert a Galvanometer into an Ammeter, a very low resistance known as "shunt" resistance is connected in parallel to Galvanometer. Value of shunt is so adjusted that most of the current passes through the shunt.

Critical Analysis / Conclusion

After performing this lab tasks/experiments, we can understand the concept and working of voltmeter (for measuring voltage) and ammeter (for measuring currents) that are designed by using galvanometer (a sensitive device which can measure very small currents accurately) by converting it. We can also verify the values of voltage and current measured by designed voltmeter and ammeter to values of voltage and current measured by digital multimeter to check as mentioned in tables. We can also determine the internal resistance of voltage source. We are able to theoretically solve the circuit shown in circuit diagrams for verify. We can compare the calculated and measured values of voltage and current and find percent error. A small error may occur during observations. The results supported my observations.