KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

Electrical Engineering Department

EE 208 ELECTRICAL SYSTEMS

Experiment # 1 INTRODUCTORY EXPERIMENT

OBJECTIVE:

1 - To study various measurements meters (Ohmmeter, Voltmeter and Ammeter).
2 - To determine the resistance of a selection of resistors using different ways.

APPARATUS: DC Power Supply
Ohmmeter, Voltmeter and Ammeter
Resistor: 100 Ω, 470 Ω, 1 KΩ, 3.3 KΩ and 10 KΩ

Part I

INTRODUCTION:

In this course, three quantities will be measured using measurement devices: **Resistance** (Ω), **Voltage** (V), and **Current** (A). The three quantities are related by **Ohm's law: V = I R.**

To measure the **resistance** of a given resistor, use an **Ohmmeter**. The **isolated** resistor should be connected in **parallel** with the Ohmmeter, as shown in Figure 1.

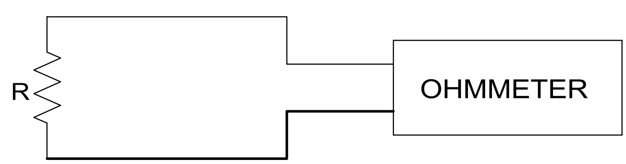


Figure 1

To measure **voltage**, use a **Voltmeter**, which consists primarily of a coil of resistance R_c and a high resistance R_s connected to each other in series as shown in Figure 2.

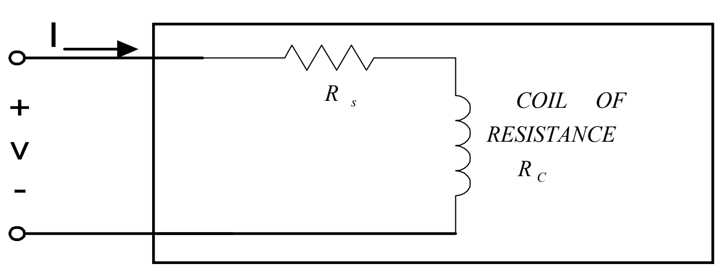


Figure 2 Voltmeter

To measure the **voltage across** a given electrical element (such as a resistor, a voltage source, or a current source), connect the Voltmeter in **parallel** with the electrical element. For instance, to measure the voltage V across the resistor R_2 shown in the circuit of Figure 3 connect the Voltmeter in parallel with R_2.

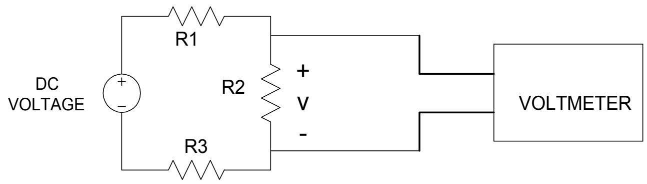


Figure 3

To measure the **current**, use an **<u>Ammeter</u>**, which consists primarily of a coil, R_c and a low resistance R_s connected to each other in parallel as shown in Figure 4.

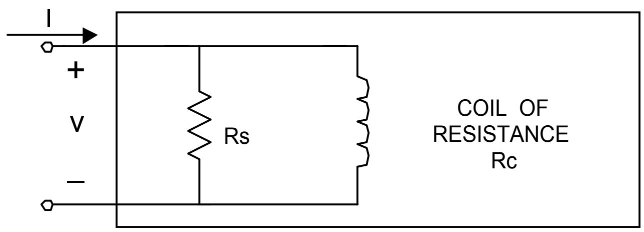


Figure 4. Ammeter

To measure the **current <u>through</u>** a given electrical element, connect the Ammeter in **<u>series</u>** with the element. For instance, to measure the current (I) passing through resistor R_2 shown in the circuit of Figure 5, the Ammeter is connected in series with R_2.

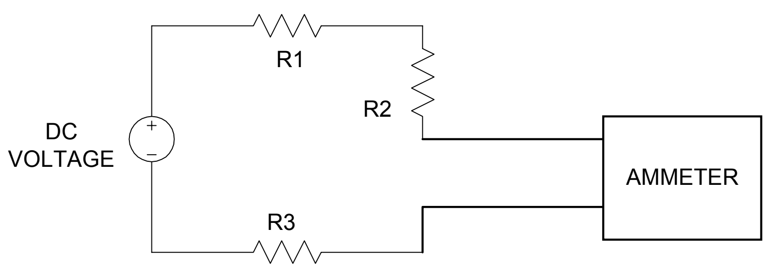


Figure 5

A device called **<u>multimeter</u>** consists of an Ohmmeter, a Voltmeter, and an Ammeter housed in one unit. There are two types of multimeters: **<u>analog multimeters</u>** and **<u>digital multimeters</u>**. The Voltmeter and the Ammeter described earlier are of the analog type. Both the analog and digital types are connected in the same manner to make a measurement.

PROCEDURE:

1- Measure the resistance of the resistors given using the Ohmmeter and record the values in Table 1.
2- Connect the circuit as shown in Figure 6, set the resistor R to 100 Ω and the DC power supply to 10 V.
3- Measure the voltage across the resistor and the current through the resistor and write the results in Table 2.
4- Determine the value of the resistance using Ohm's law R=V/I and record it in Table 2.
5- Repeat step 2 through 4 for the other resistors (470Ω, 1 KΩ, and 10 KΩ).

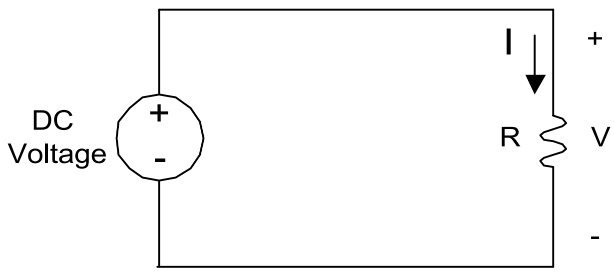


Figure 6

Part II

THEORY:

1- The basic relationship between voltage, current, and resistance is determined by Ohm's law:

$$\mathbf{V = I\,R} \qquad \textbf{(1)}$$

Where: V = Voltage across the resistor (in Volts)
I = Current through the resistor (in Amperes)
R = Resistance of the resistor (in Ohms)

2- Given any resistor, its **resistance** can be found by one of **four** methods:

a- Using the **color codes**. This value is called the nominal value, and it is only approximate.
b- Direct measurement using an **Ohmmeter**.
c- Measuring the voltage across the resistor and the current through the resistor, then applying **Ohm's law**.
d- By **plotting** the **voltage** versus the **current**. The resulting graph is usually a straight line and the **slope** of this straight line equals the value of the resistance R, as seen in figure 7. Resistance that has a straight-line relationship between V and I is said to be operating in the linear region.

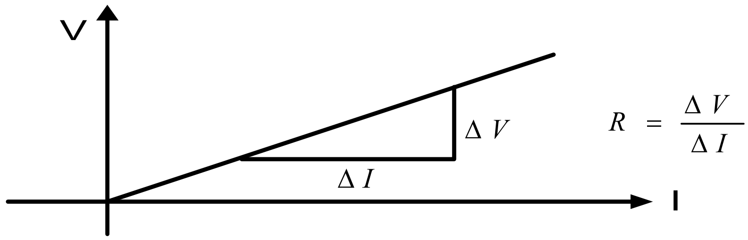


Figure 7

Note:

Resistors that are operated over the power rating will deviate from the straight-line relationship between V and I. The resistor in this case is operating in the non-linear region. In such a case, the resistance is no longer equal the slope of the V versus I graphs. It may however, be calculated using the ratio V/I.

PROCEDURE:

You will be supplied with sets of 5 resistors.

1- Find the nominal value and the tolerance of each resistance using the **color codes**. Record your results in Table 3.
2- Using an **ohmmeter**, measure and record the resistance of each resistor in Table 3.
3- Connect the circuit as shown in Figure 8 for R = 100 Ω and perform the following:
   a- Set the source voltage V_s to 12 V.
   b- Measure V and I.
   c- Repeat steps 3a and 3b for remaining resistors.
   d- Record your results in Table 3.

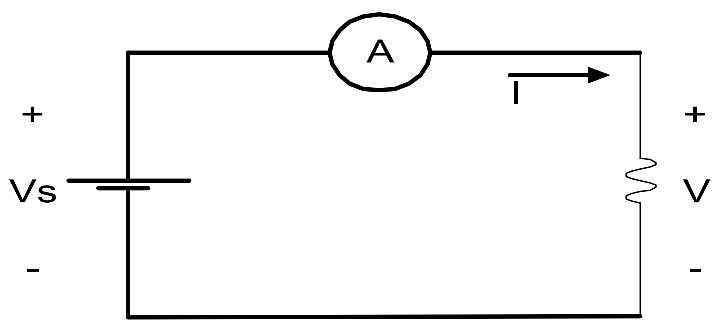


Figure 8

4- Using **R = 3.3 KΩ,** vary the input voltage V_s from –10 to 10 volts (negative voltage are obtained by reversing the leads of the supply) and measure V and I in steps of 2 volts. Record the readings in Table 4.

REPORT:

a- Complete Tables 1 through 4.
b- Plot the voltage – current characteristic obtained in step 4 of part II. Calculate the slope and check if that is equal to the resistance.

EXPERIMENT #1 Laboratory Report

Name: .... **I.D.** .... **Lab. Section:** ....

TABLE 1

Resistor	**R_1**	**R_2**	**R_3**	**R_4**
Nominal value (Ω)	100	470	1,000	10,000
Ohmmeter reading (Ω)				

TABLE 2

Nominal Value (Ω)	**100**	**470**	**1,000**	**10,000**
Voltage (V)				
Current (A)				
Value using (R =V/I)				

TABLE 3

Resistor Values:

Resistor	**R1**	**R2**	**R3**	**R4**	**R5**
Nominal value					
Tolerance value					
Ohmmeter reading					
Voltage (V)					
Current (mA)					
Resistance from R = V/I					

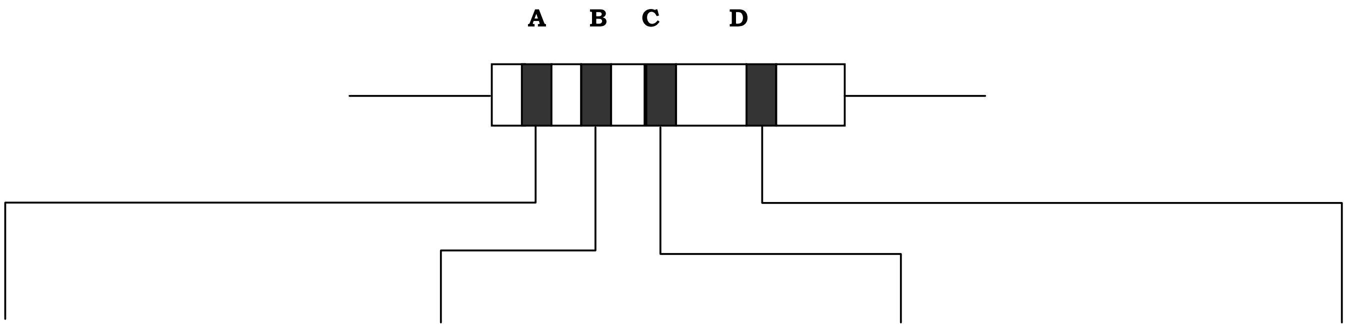
TABLE 4

V-I Characteristic: (R = 3.3 KΩ)

V (volts)	-10	-8	-6	-4	-2	2	4	6	8	10
I (mA)										

Resistance = Slope of the line =

Resistor Color Code



A: FIRST BAND
1ST SIGNIFICANT FIGURE

COLOR	DIGIT
BLACK	0
BROWN	1
RED	2
ORANGE	3
YELLOW	4
GREEN	5
BLUE	6
VIOLET	7
GRAY	8
WHITE	9

B: SECOND BAND
2ST SIGNIFICANT FIGURE

COLOR	DIGIT
BLACK	0
BROWN	1
RED	2
ORANGE	3
YELLOW	4
GREEN	5
BLUE	6
VIOLET	7
GRAY	8
WHITE	9

C: THIRD BAND
MULTIPLIER

COLOR	DIGIT
SILVER	
OLD	
-1	
BLACK	0
BROWN	1
RED	2
ORANGE	3
YELLOW	4
GREEN	5
BLUE	6
VIOLET	7
GRAY	8
WHITE	9

D: FOURTH BAND
TOLERENCE

COLOR	DIGIT
WITHOUT	20 %
SILVER	10 %
GOLD	5 %
RED	2 %
BROWN	1 %

EXAMPLES

YELLOW	VIOLET	BROWN	SILVER	BROWN	RED	ORANGE	GOLD

4	**7**	**0**	**10 %**	**=470, 10%**	**1**	**2**	**000**	**5 %**	**=12KΩ, 5%**