Laboratory Manual

EE-153L – Introduction to Electrical Engineering

Fall 2025

Instructor

Engr. Noman Khan

Lab Engineers

Engr. Bilal Haider
Engr. Yasir Kamal

Department of Electrical Engineering
Pakistan Institute of Engineering & Applied Sciences
Islamabad, Pakistan

Experiment 5

Series Resistive Circuit

5.1 Objective

The focus of this exercise is an examination of basic series DC circuits with resistors. A key element is Kirchhoff's Voltage Law, which states that the sum of voltage rises around a loop must equal the sum of the voltage drops. The voltage divider rule will also be investigated.

5.2 Theory Overview

A series circuit is defined by a single loop in which all components are arranged in daisy-chain fashion. The current is the same at all points in the loop and may be found by dividing the total voltage source by the total resistance. The voltage drops across any resistor may then be found by multiplying that current by the resistor value. Consequently, the voltage drops in a series circuit are directly proportional to the resistance. An alternate technique to find the voltage is the voltage divider rule. This states that the voltage across any resistor (or combination of resistors) is equal to the total voltage source times the ratio of the resistance of interest to the total resistance.

5.2.1 Pre-Lab Task

Before performing the experiment in the laboratory, complete the following tasks in **LTspice** to demonstrate your understanding of the theoretical concepts. These preparatory tasks will help you predict circuit behavior and verify your results during the lab session.

5.3 Equipment

- Adjustable DC Power Supply
- Digital Multimeter
- 1 kΩ ___________________
- 2.2 kΩ ___________________
- 3.3 kΩ ___________________
- 6.8 kΩ ___________________

5.4 Schematics

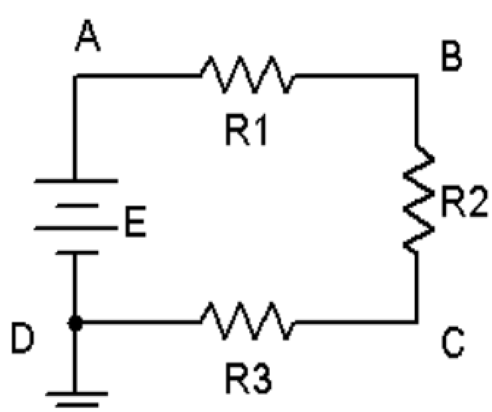

Fig 5.1

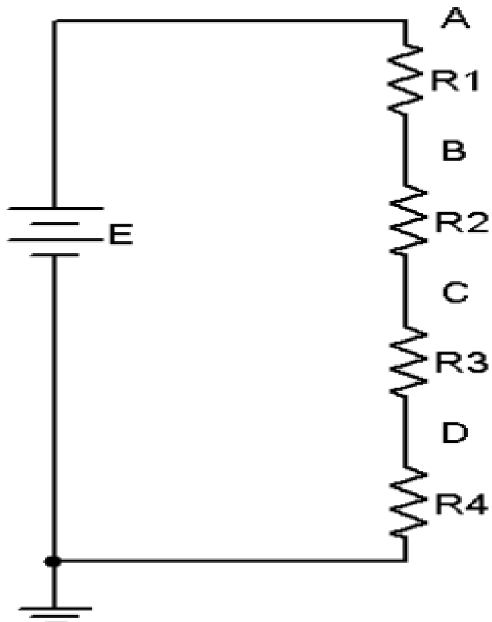

Fig 5.2

5.5 Procedure

1. Using the circuit of Figure 5.1 with R1 = 1 k, R2 = 2.2 k, R3 = 3.3 k, and E = 10 volts, determine the theoretical current and record it in Table 5.1. Construct the circuit. Set the DMM to read DC current and insert it in the circuit at point A. Remember, ammeters go in-line and require the circuit to be opened for proper measurement. The red lead should be placed closer to the positive source terminal. Record this current in Table 5.1. Repeat the current measurements at points B and C.

2. Using the theoretical current found in Step 1, apply Ohm's law to determine the expected voltage drops across R1, R2, and R3. Record these values in the Theory column of Table 5.2.

3. Set the DMM to measure DC voltage. Remember, unlike current, voltage is measured across components. Place the DMM probes across R1 and measure its voltage. Again, red lead should be placed closer to the positive source terminal. Record this value in Table 5.2. Repeat this process for the voltages across R2 and R3. Determine the percent deviation between theoretical and measured for each of the three resistor voltages and record these in the final column of Table 5.2.

4. Consider the circuit of Figure 5.2 with R1 = 1 k, R2 = 2.2 k, R3 = 3.3 k, R4 = 6.8 k and E = 20 volts. Using the voltage divider rule, determine the voltage drops across each of the four resistors and record the values in Table 5.3 under the Theory column. Note that the larger the resistor, the greater the voltage should be. Moreover, determine the potentials V_{AC} and V_B, again using the voltage divider rule.
5. Construct the circuit of Figure 5.2 with R1 = 1 k, R2 = 2.2 k, R3 = 3.3 k, R4 = 6.8 k and E = 20 volts. Set the DMM to measure DC voltage. Place the DMM probes across R1 and measure its voltage. Record this value in Table 5.3. Moreover, determine the deviation. Repeat this process for the remaining three resistors.

6. To find V_{AC}, place the red probe on point A and the black probe on point C. Similarly, to find V_B, place the red probe on point B and the black probe on ground. Record these values in Table 5.3 with deviations.

5.6 Data Tables

Table 5.1

I Theory	I Point A	I Point B	I Point C

Table 5.2

Voltage	Theory	Measured	Deviation
R1			
R2			
R3			

Table 5.3

Voltage	Theory	Measured	Deviation
R1			
R2			
R3			
R4			

V_{AC}			
V_B			

5.6 Questions

1. For the circuit of Figure 5.1, what is the expected current measurement at point D?

2. For the circuit of Figure 5.2, what are the expected current and voltage measurements at point D?

3. In Figure 5.2, R4 is approximately twice the size of R3 and about three times the size of R2. Would the voltages exhibit the same ratios? Why/why not? What about the currents through the resistors?

4. If a fifth resistor R5 of 10 kΩ added below R4 in Figure 5.2, how would this alter V_{AC} and V_B? Show work.

5. Is KVL satisfied in Tables 5.2 and 5.3?

5.7 Conclusion

Assessment

Sr. No.	Specific Course Learning Outcomes	Knowledge Domains	Performance indicator
	Upon completion of this course, the students will be able to		
1	**USE** electronic lab instruments including the digital multi-meter, function generator, oscilloscope and electronic circuit trainer.	P1	• Proper wiring of the circuit • Correct use of instruments (signal generator, oscilloscope) • Data recorded in table
2	**CONSTRUCT** and **ANALYZE** basic circuits.	P2	• Relate experiment with theoretical concept discussed in class. • Describe relevant mathematical equations • Discuss discrepancies between theoretical, simulation and experimental results • Possible sources of discrepancies and ways to improve
3	**COMMUNICATE** clearly and effectively through presentation and/or report.	A2	• Report is structured properly • Figures and Graphs annotated • Language is clear
4	**DEMONSTRATE** teamwork and show commitment to the group in achieving the objectives of laboratory.	A2	• Does his/her part in the group • Listen to other's ideas • Does not argue
5	**DEMONSTRATE** punctuality, dress appropriately and comply with the standard safety procedures of the lab.	A2	• Wear proper dress to perform the tasks and Follow lab timing • Follow safety instructions for handling the instruments.