Brac University

Department of Electrical & Electronic Engineering

Semester Summer-24

Course Number: EEE101L

Course Title: Electrical Circuits I Laboratory

Section: 06

Lab Report

Experiment no. 03

Name of the experiment: Verification of Superposition Principle (Software Simulation)

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Group Number: **02**

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Electrical Circuits I Laboratory

EEE 101L

Department of Electrical & Electronic Engineering (EEE)

Brac University

Experiment No. 3

Verification of Superposition Principle

1. **Objective:** To verify experimentally the Superposition theorem which is an analytical technique of determining currents in a circuit with more than one emf source.

2. **Theoretical Background:** In a linear circuit containing multiple independent sources and linear elements (e.g. resistors, inductors, capacitors) the voltage across (or the current through) any element when all the sources are acting simultaneously may be obtained by adding algebraically all the individual voltages (or the currents) caused by each independent source acting alone, with all other sources deactivated.

   An independent voltage source is deactivated (made zero) by shorting it and an independent current source is deactivated (made zero) by open circuiting it. However, if a dependent source is present, it must remain active during the superposition process.

3. **Equipment:**

   - Two DC power supplies adjusted to 10V and 20V
   - Resistors: 1kΩ, 2.2kΩ, 3.3kΩ, 4.7kΩ and 5.6kΩ
   - Bread board/ Trainer board
   - One digital Multimeter (DMM)

4. Circuit Diagram:

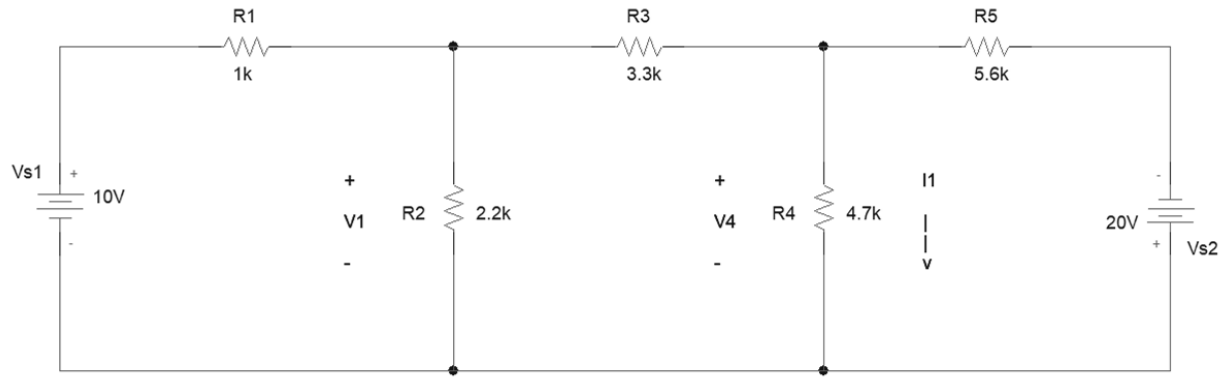


Fig. 1

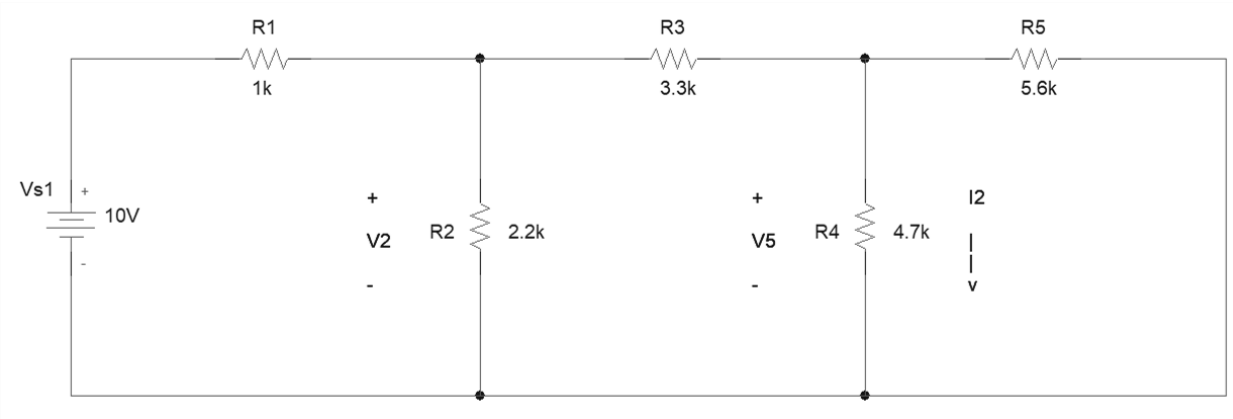


Fig. 2

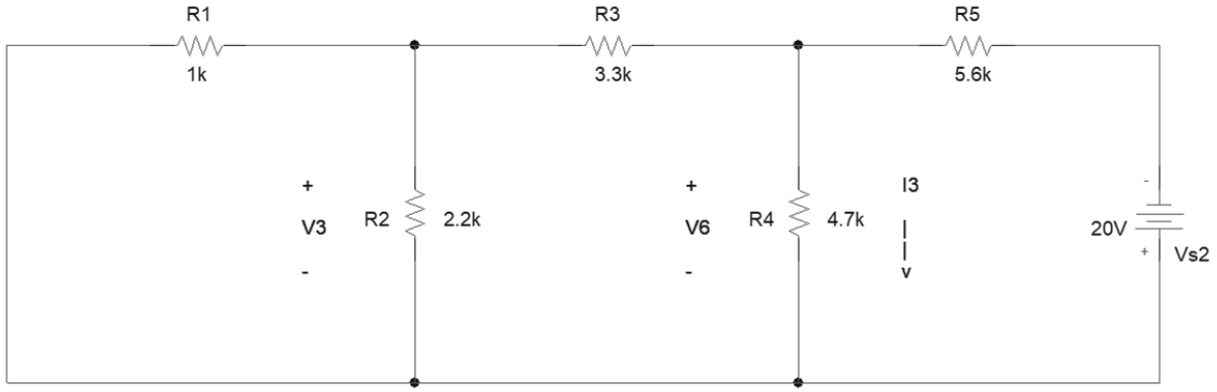
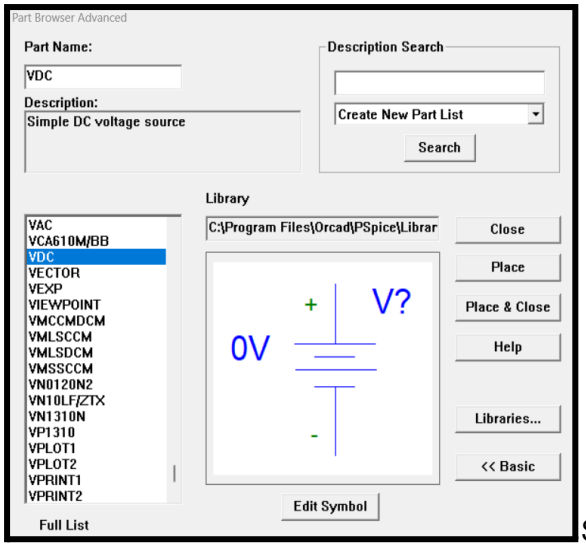


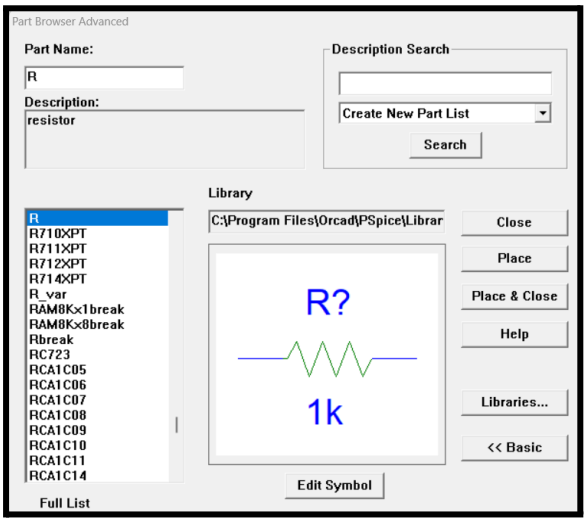
Fig. 3

5. Procedure:

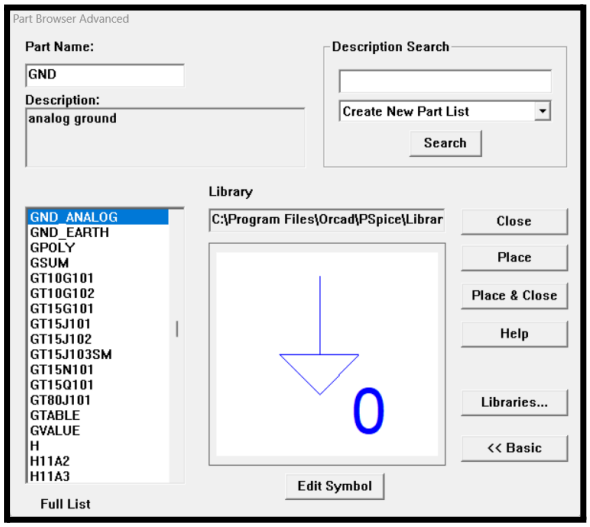
i. Setup the circuit as in Fig. 1.
ii. Measure resistor values accurately with DMM.



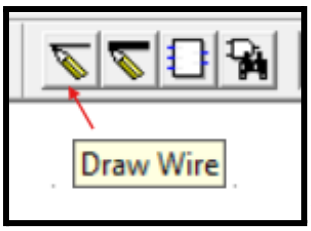
Selection of Voltage Source



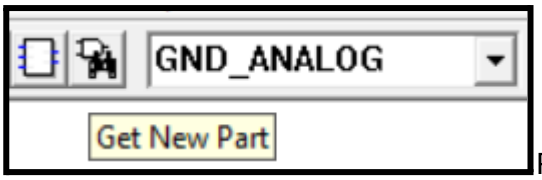
Selection of Resistor



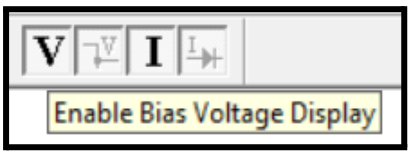
Selection of Ground



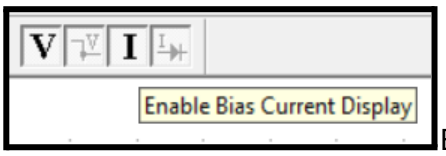
Wire tool



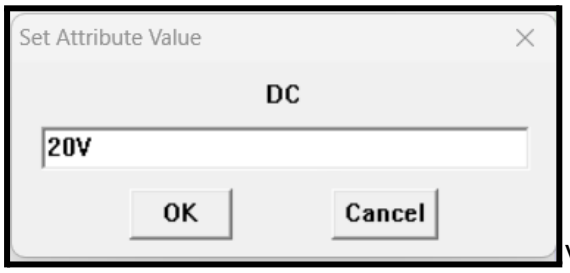
Parts menu



Bias Voltage



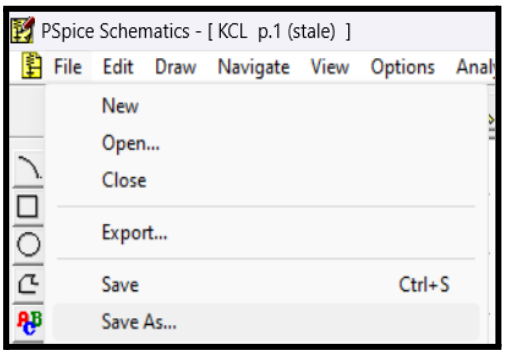
Bias Current



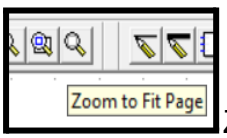
VDC Set (Voltage source value set)

Resistor set (R value set)

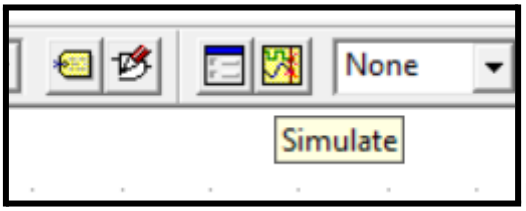
Text tools



File saving



Zoom



Begin Simulation

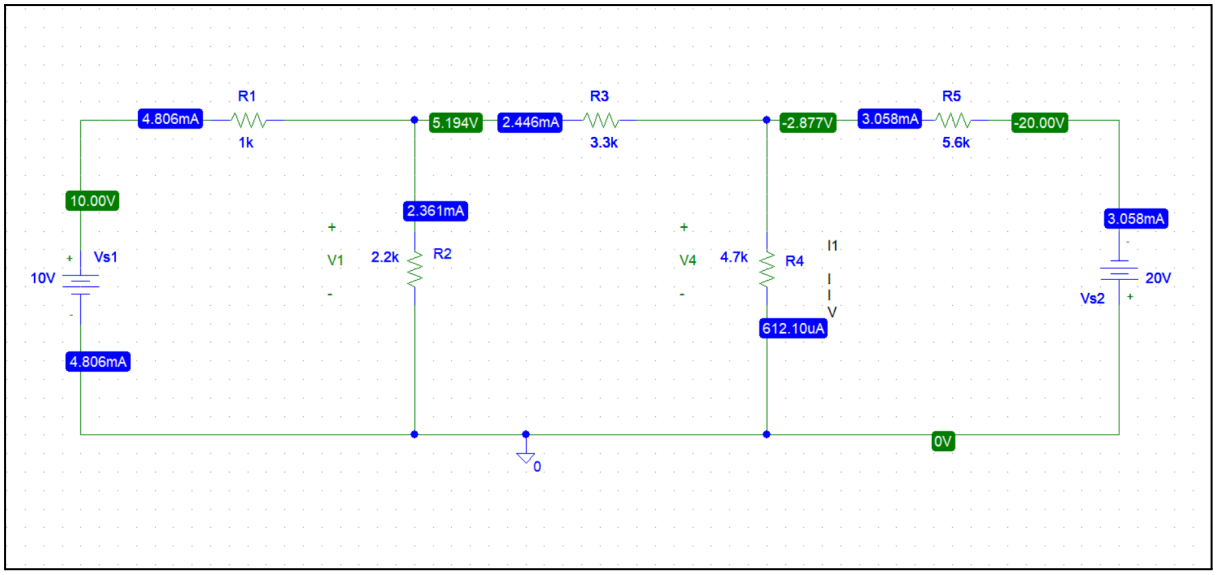


Fig.1 Simulated with both voltage source (Vs1 and Vs2)

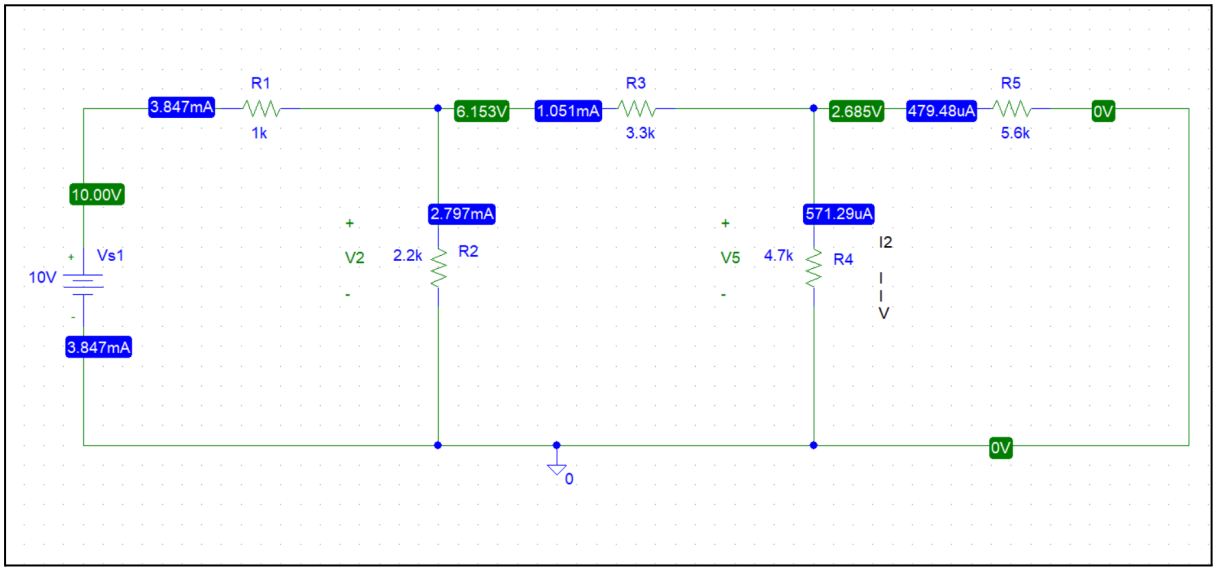


Fig.2 Simulated with only Vs1 active

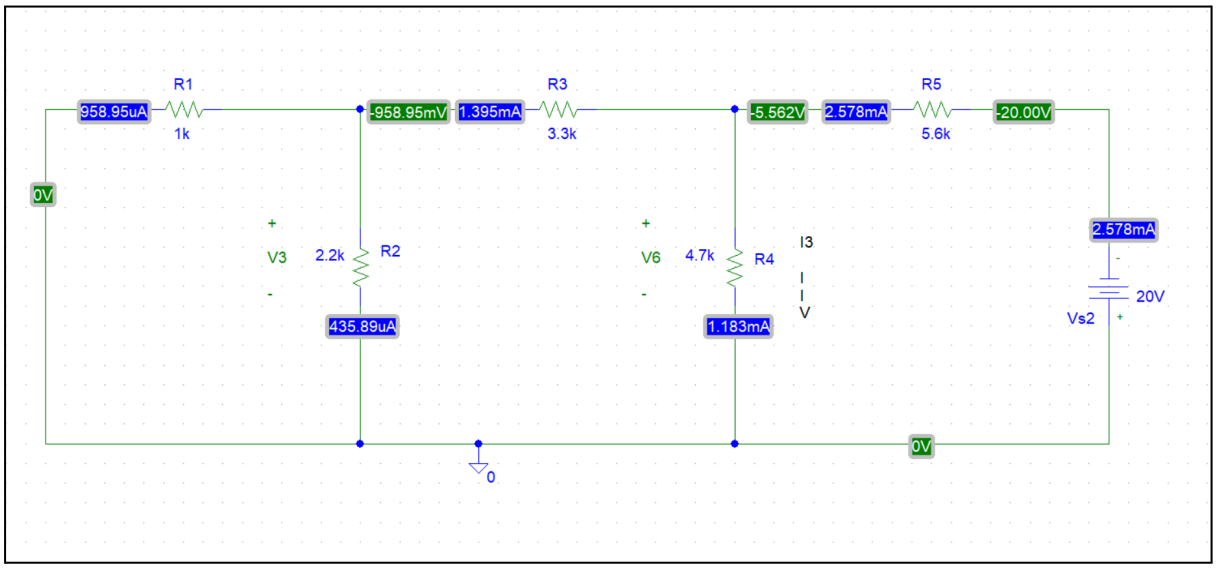


Fig.3 Simulated with only Vs2 active

iii. Apply V_{s1} = 10 volts from one source and V_{s2} = 20 volts from another source. Measure voltages accurately with DMM.
iv. Measure V_1 with DMM. Measure V_4 and calculate the current I_1 and record it in the given table.
v. Render V_{s2} inactive (keeping V_{s1} active) and measure V_2. Measure V_5 and calculate I_2.
vi. Render V_{s1} inactive (keeping V_{s2} active) and measure V_3. Measure V_6 and calculate I_3.
vii. Verify if $V_1 = V_2 + V_3$ and $I_1 = I_2 + I_3$ which would validate the superposition theorem for this particular circuit.

6. Data Table:

Fig. 1

R4 (kΩ)	V1 (V)	V4 (V)	$I_1 = V_4 / R_4$ (mA)
4.7	5.194	-2.877	-0.6121

Fig. 2

V2 (V)	V5 (V)	$I_2 = V_5 / R_4$ (mA)
6.153	2.685	0.571

Fig. 3

V3 (V)	V6 (V)	$I_3 = V_6 / R_4$ (mA)
-0.958	-5.562	-1.183

Verification

V1 (V)	$V_2 + V_3$ (V)	I1 (mA)	$I_2 + I_3$ (mA)
5.194	5.195	-0.6121	-0.612

V4 (V)	V5+V6 (V)
-2.877	-2.877

Faculty Signature and Date

7. Question:

1. “Although Superposition Principle can be used to determine voltage and current in a linear circuit, it cannot be used to determine power.” --- Elucidate the statement.

Discussion of the software simulation

Equipments required:

1. PSpice Schematics software
2. Suitable device (PC or Laptop)

Simulation procedure:

Circuit figure.1

1. Open PSpice Schematics software.
2. Open the parts menu (click on the icon).
3. Search the necessary parts for making a series-parallel circuit (VDC, GND, R).
4. Place the parts on designated places following the provided diagram and close the parts menu.
5. Use Ctrl+R to rotate the second voltage source.
6. Using the wire tool connect all the parts in the circuit.
7. Set the values of all the parts.
8. Rename all the parts for easier identification (VDC=Vs1 and rotated VDC=Vs2)
9. Use the Draw Text and Text Box tool to mark necessary information.
10. Enable Bias Voltage and Current display.
11. Use the zoom to fit page tool.
12. Save the file with a suitable name.
13. Begin circuit simulation.
14. Attach a screenshot of the circuit in the report document.
15. Fill out the data table with necessary values and calculate $I_1=V_4/R_4$

Circuit figure.2

1. Click the second voltage source (Vs2, 20V) and highlight it (It will be red when highlighted) and press the delete key on the keyboard to remove it.
2. Use the wire tool to bridge the missing connection of Vs2.
3. Run the simulation again.
4. Fill out the data table with necessary values and calculate $I_2=V_5/R_4$

Circuit figure.3

1. Click the first voltage source (Vs1, 10V), highlight it and remove it using the delete key on the keyboard.
2. Use the wire tool to bridge the missing connection of Vs1.
3. Highlight the wire which is at the end of R5 and remove it.
4. Open the parts menu, select a new voltage source (VDC) and place it according to the diagram.
5. Change the name of this VDC back to Vs2.
6. Set the value of Vs2 to 20V.
7. Run the simulation again.
8. Fill out the data table with necessary values and calculate $I_3=V_6/R_4$

Verification table

Using the information from the data table, calculate V5+V6. After that, verify V1=V2+V3 and I1=I2+I3. Using the answer, validate the superposition theorem for the circuit.