Khwaja Yunus Ali University

Lab Report -06

Name of the Department: Computer Science and Engineering

Course Code: CSE 0713-1105

Course Title: Electrical Circuit Lab

Experiment No.: 06

Name of the Experiment : Verification of Superposition Theorem Using Hardware and Digital Simulation .

Date of Experiment : 27-03-2025

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Instructor Signature & Date

Submitted by –	**Submitted to –**

Name: MD.Sabbir Hossain Rahat
ID Number: 06224205101017
Batch No: 18th
Semester: 1st Year 2nd Semester
Khwaja Yunus Ali University

Name: Sakil Ahammed
Lecturer
Department of EEE
Khwaja Yunus Ali University

No. of the Experiment : 06

Name of the Experiment: Verification of Superposition Theorem Using Hardware and Digital Simulation.

Objective:

To verify the Superposition Theorem using digital simulation software (Proteus) and compare the calculated and simulated results.

Theory:

Superposition theorem states that in any linear, active, bilateral network having more than one source, the response across any element is the sum of the responses obtained from each source considered separately and all other sources are replaced by their internal resistance.

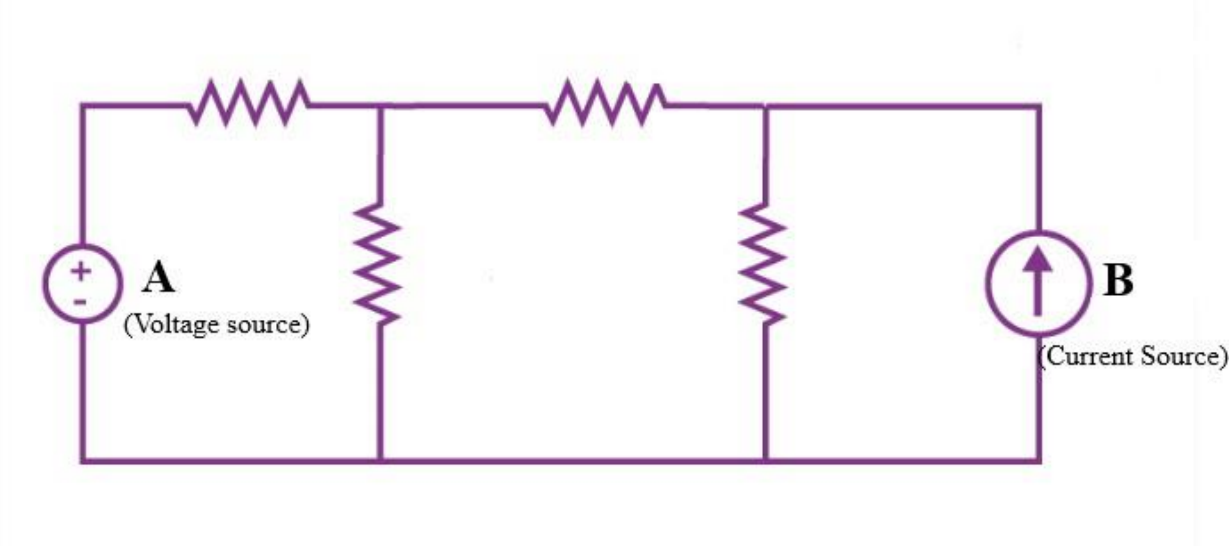

Fig. 01: Super position theorem example

Here, for calculate according to Superposition theorem , firstly we have to calculate with **A** source and then source **B** .

Circuit Diagram :

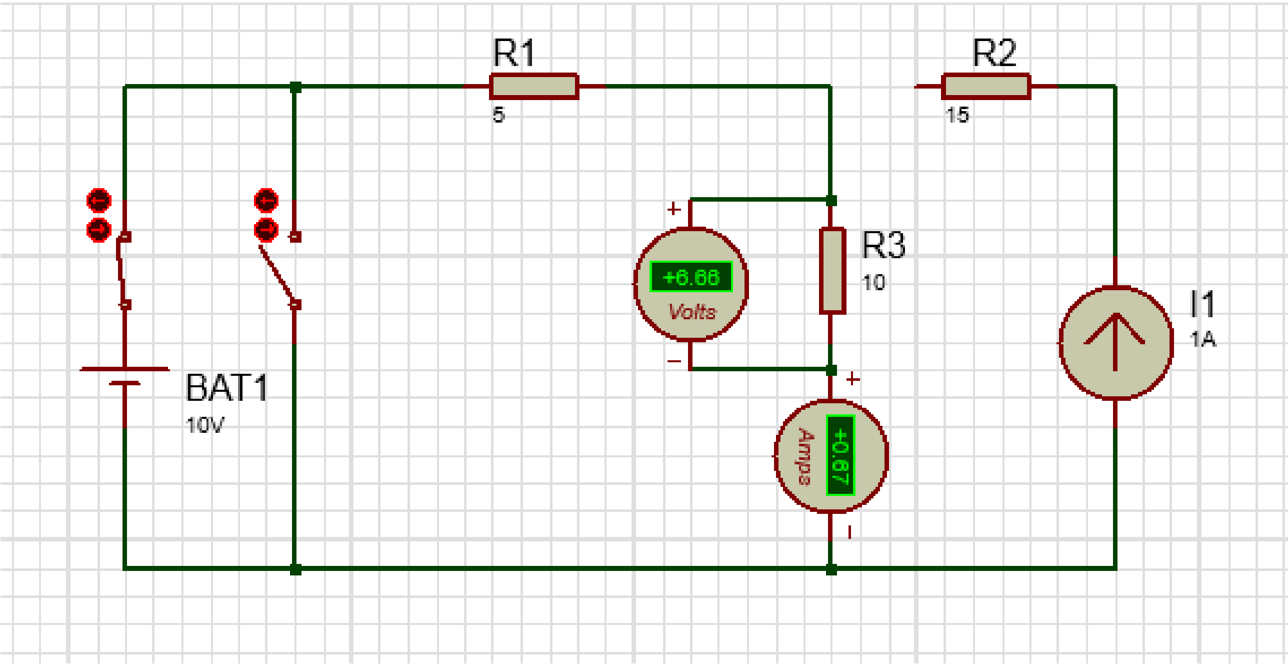

Fig. 02: Super position theorem simulation When Voltage Source is Active (Using Proteus 8 pro.)

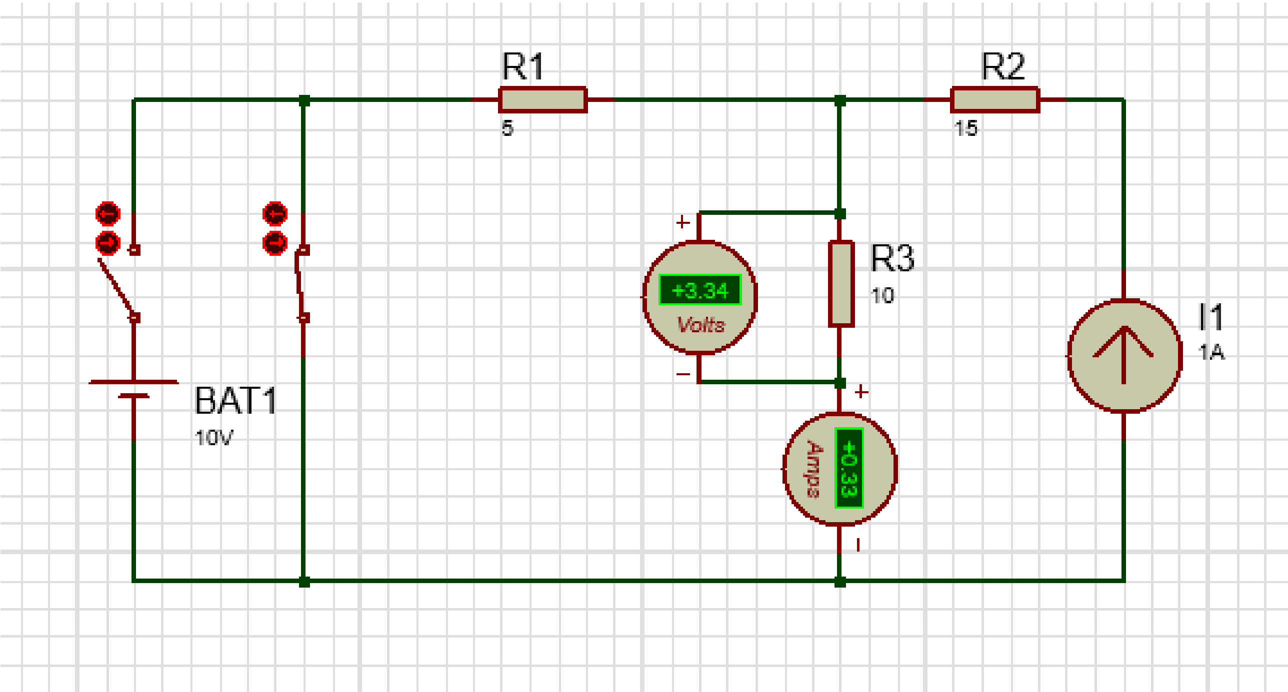

Fig. 03: Super position theorem simulation When Current Source is Active (Using Proteus 8 pro.)

Apparatus Used:

- Software: Proteus 8 Professional
- DC Voltage
- DC Current
- Resistors
- Voltmeter & Ammeter
- Connecting Wires

Working Procedure:

1. I designed the circuit in Proteus using one voltage source (10V) and one current source (1A) along with three resistors.
2. I used switches to isolate the voltage source and the current source individually so that I could apply the Superposition Theorem properly.
3. First, I kept the current source open (disabled) and activated only the voltage source. I measured the voltages and currents using virtual meters.
4. Then, I shorted (disabled) the voltage source and activated only the current source. I took the readings again.
5. I found the total response by algebraically adding the responses obtained from each individual source.
6. I recorded all the measurements and performed theoretical calculations using Ohm's Law and basic circuit laws.
7. Finally, I compared the results from the simulation with theoretical calculations.

Calculations:

Given:

- Voltage source: 10V
- Current source: 1A
- R1 = 5Ω, R2 = 15Ω, R3 = 10Ω

Firstly,

When Only Voltage Source is Active (Current Source Open) :

- Total resistance in series:

$$R_{\text{total}} = R1 + R3 = 5\Omega + 10\Omega = 15\Omega$$

- Current through the loop:

$$I = \frac{V}{R_{total}} = \frac{10\text{ V}}{15\Omega} = 0.666\text{ A}$$

- Voltage across R3:

$$V_{R3} = I \times R3 = 0.666\text{ A} \times 10\Omega = 6.66\text{ V}$$

Secondly,

When Only Current Source is Active (Voltage Source Shorted) :

- R1 and R2 are in series:

$$R_{eq1} = R1 + R2 = 5\Omega + 15\Omega = 20\Omega$$

- R3 is in parallel with R_eq1:

$$\frac{1}{R_{total}} = \frac{1}{R_{eq}} + \frac{1}{P3} = \frac{1}{20} + \frac{1}{10} = \frac{3}{20}$$

$$R_{total} = \frac{1\ 20}{3} \approx 6.67\Omega$$

- Voltage across R3:

$$V = I \times R_{total} = 1A \times 6.67\Omega = 6.67V$$

- Current through R3 (by Ohm's Law):

$$I_{R3} = \frac{V}{R3} = \frac{6.67V}{10\Omega} \approx 0.667\text{ A}$$

Then,

Total Response by Superposition :

- Voltage across R3:

$$V_{R3(\text{ Total })} = V_{R3(\text{ VoltageSource })} + V_{R3(\text{ CurrentSource })}$$
$$= 6.66\text{ V} + 3.32\text{ V} = 9.98\text{ V} \approx 10\text{ V}$$

- Current through R3:

$$I_{R3(\text{ Total })} = 0.333A(\text{ VoltageSource }) + 0.333A(\text{ CurrentSource }) = 0.666A$$

Observation Table:

Source Condition	Voltage across R3 (V)	Current through R3 (A)
Only Voltage Source	6.66V	0.333A
Only Current Source	3.32V	0.333A
Total (By Superposition)	9.98V ≈ 10V	0.666A
From Simulation	10V	0.66A

Result and Discussion:

- Across R_3 when voltage source is active voltage is 6.66 V and current 0.333A, then when current source is active current is 0.333A and voltage 3.32 V . And after calculation and simulation , total is 10 V and 0.66 A .
- The experimental and theoretical values are almost the same, verifying the Superposition Theorem.
- Minor differences in values may be due to simulation rounding or display limitations.
- Both sources acting together produced a result that matched the sum of individual contributions.

Conclusion:

The Superposition Theorem was successfully verified using simulation in Proteus. The total response of the circuit matched the sum of individual responses from each source, validating the theoretical **Super position theorem** principle.