

Week-7

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Course Code: Cse250

Experiment No: 4

Experiment Name:

Verification of Superposition Principle

Deadline: 8th Dec 2021

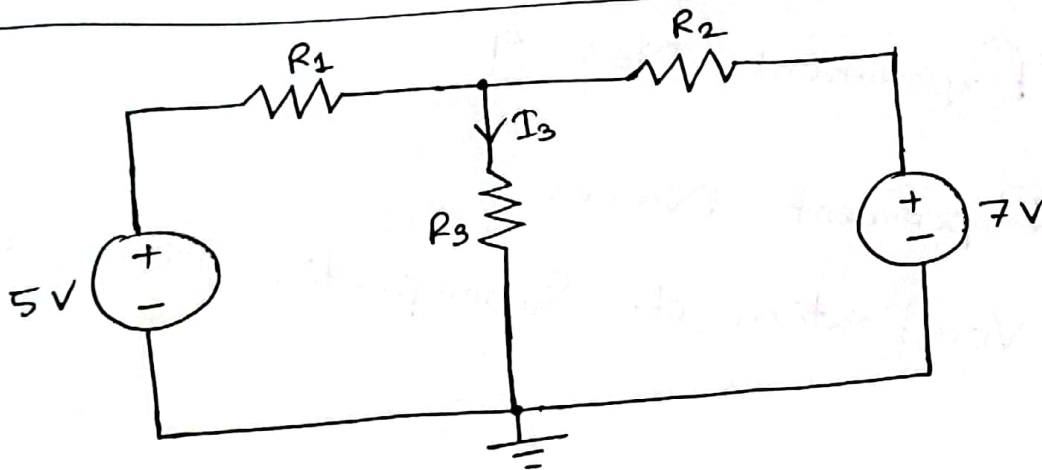
① Objective:

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

② Apparatus:

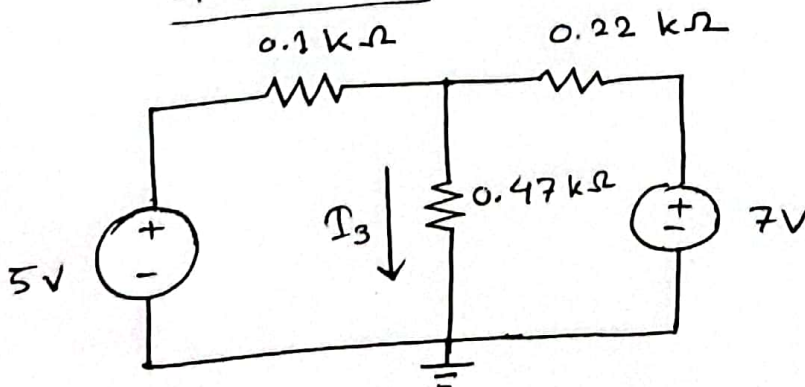
- ↳ Two DC power supplies.
- ↳ One multimeter

③ Circuit / Block / System Diagram:



④ Result / Analysis:

Circuit No - 1:

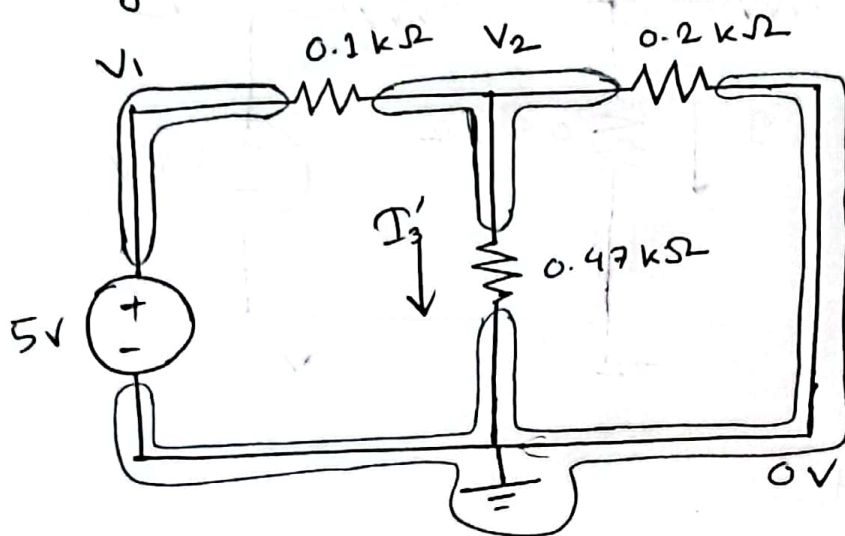


$$I_3 = I_3' + I_3''$$

④ → Continuation.

③

Considering 5V voltage source active/alive only,



$$V_1 = 5 \text{ Volt.}$$

$$V_2 \left(\frac{1}{0.1} + \frac{1}{0.22} + \frac{1}{0.47} \right) - \frac{V_1}{0.1} - \frac{0}{0.22} - \frac{0}{0.47} = 0$$

$$\Rightarrow V_2 \times \left(\frac{8620}{517} \right) = 0.05$$

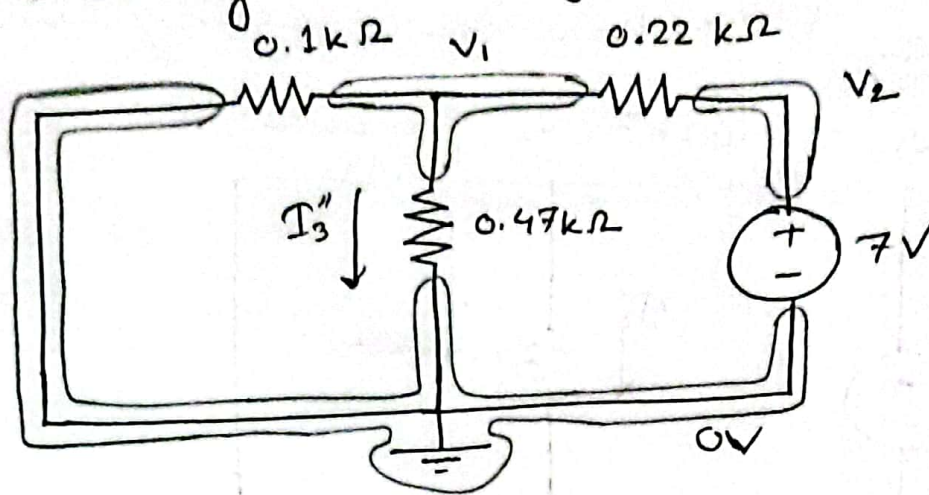
$$\Rightarrow V_2 = 2.9988 \text{ Volt.}$$

$$\therefore I_3' = \frac{2.9988 - 0}{0.47 \times 10^3}$$

$$\Rightarrow I_3' = 6.3805 \times 10^{-3} \text{ A}$$

④ → cont.

④ Now, considering 7V voltage source active only,



$$V_2 = 7 \text{ Volt.}$$

$$V_1 \left(\frac{1}{0.1} + \frac{1}{0.22} + \frac{1}{0.47} \right) - \frac{0}{0.1} - \frac{7}{0.22} - \frac{0}{0.47} = 0$$

$$\Rightarrow V_1 = \frac{7}{0.22 \times 10^3} \times \frac{25850}{431}$$

$$V_1 = 1.90835 \text{ Volt}$$

$$\therefore I_3'' = \frac{1.90835 - 0}{0.47 \times 10^3}$$

$$= 4.0603 \times 10^{-3} \text{ A}$$

We know,

$$I_3 = I_3' + I_3''$$

$$= (6.3805 \times 10^{-3}) + (4.0603 \times 10^{-3})$$

$$= 10.4408 \times 10^{-3} \text{ A}$$

$$= 0.0104408 \text{ A.}$$

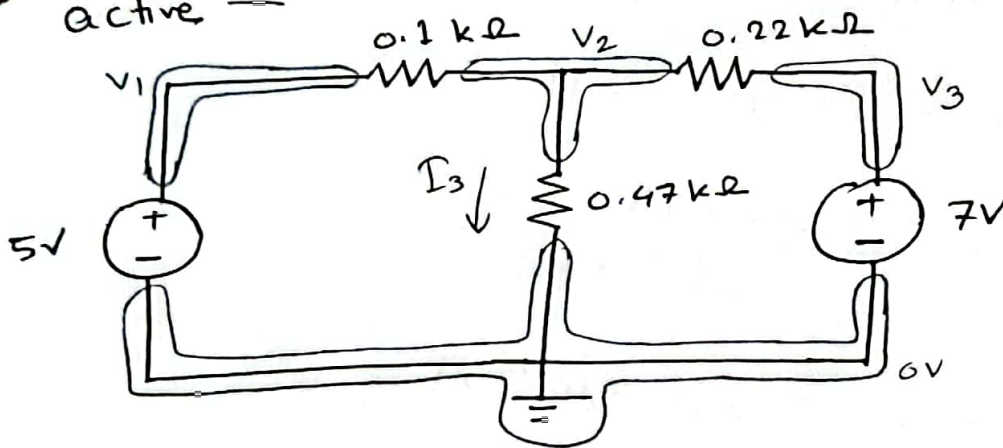
④ → Continuation.

⑤

Table - 1 :

| Observation | R_1 ($k\Omega$) | R_2 ($k\Omega$) | R_3 ($k\Omega$) | I_3' (mA) (only E_1 is active) | I_3'' (mA) (only E_2 is active) | I_3' + I_3'' (mA) | I_3 (mA) (both active) |
|-------------|------------------------|------------------------|------------------------|---|---|--------------------------------|--------------------------------|
| Simulation | 0.1 | 0.22 | 0.47 | 6.38 | 4.06 | 10.4 | 10.4 |
| Theoretical | 0.1 | 0.22 | 0.47 | 6.3805 | 4.0603 | 10.4408 | 10.4408 |

Considering both 5V and 7V voltage sources are active —



$$V_1 = 5 \text{ volt}, \quad V_3 = 7 \text{ Volt}$$

$$V_2 \left(\frac{1}{0.1} + \frac{1}{0.22} + \frac{1}{0.47} \right) - \frac{5}{0.1} - \frac{0}{0.47} - \frac{7}{0.22} = 0$$

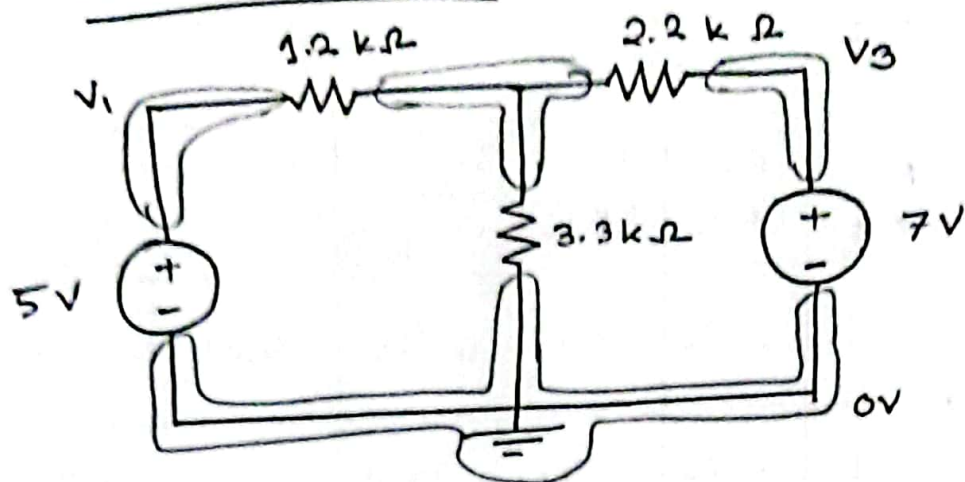
$$V_2 \times \frac{431}{25850} = \frac{9}{110}$$

$$V_2 = \frac{4.907192575}{1}$$

$$V_2 = 4.90719 \text{ Volt}$$

$$I_3 = \frac{V_2}{R_3} = \frac{4.90719}{0.47 \times 10^3} = 10.4408 \times 10^{-3} \text{ A}$$

Circuit No. - 2 :



Here, $V_1 = 5 \text{ Volt}$, $V_3 = 7 \text{ Volt}$.

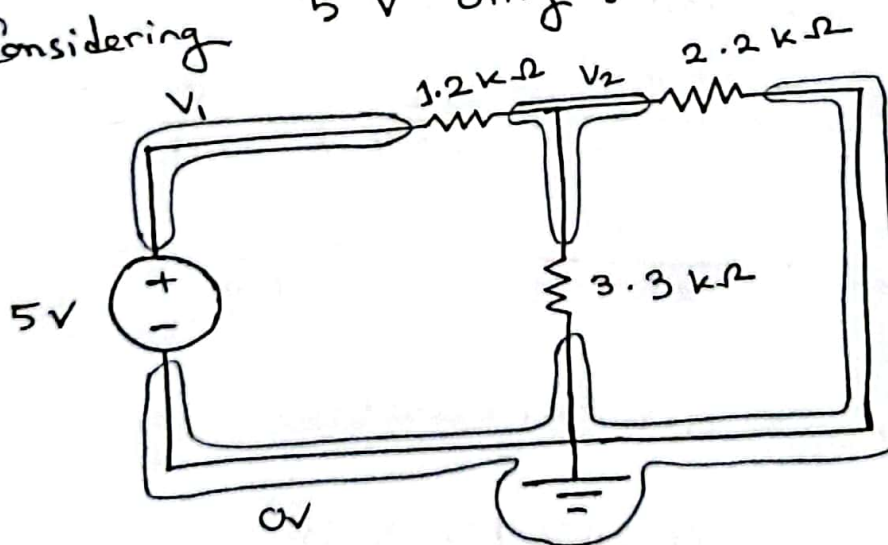
$$V_2 \times \frac{7}{4400} = \frac{97}{13200}$$

$$\Rightarrow V_2 = 4.619048 \text{ Volt}$$

$$\therefore I_3 = \frac{4.619048 - 0}{3.3 \times 10^3}$$

$$= 1.3997 \times 10^{-3} \text{ A}$$

☐ Considering 5V only :



Here, $V_1 = 5 \text{ Volt}$.

(7)

$$V_2 = \left(\frac{1}{1.2} + \frac{1}{2.2} + \frac{1}{3.3} \right) - \frac{5}{1.2} = 0$$

$$\Rightarrow V_2 \times \frac{7}{4400} = \frac{5}{1.2 \times 10^3}$$

$$\therefore V_2 = 2.619048 \text{ Volt}$$

$$\therefore I_3' = \frac{2.619048 - 0}{3.3 \times 10^{-3}} \text{ A}$$

$$= \cancel{79.365079 \times 10^{-3}} \text{ A}$$

$$= 7.936507936 \times 10^{-4} \text{ A}$$

▣ Considering 7V only:

Here, $V_1 = 7 \text{ Volt}$

$$V_2 = \frac{7}{2.2 \times 10^3} \times \frac{4400}{7}$$

$$= 2 \text{ volt}$$

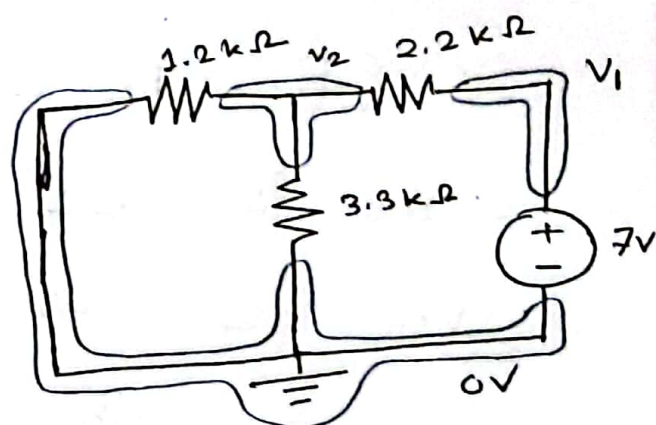
$$\therefore I_3'' = \frac{2 - 0}{3.3 \times 10^3} \text{ A}$$

$$= 6.060606 \times 10^{-4} \text{ A}$$

$$\therefore I_3 = I_3' + I_3''$$

$$= (7.936507936 \times 10^{-4}) + (6.060606 \times 10^{-4})$$

$$= 1.3997114 \times 10^{-3} \text{ A}$$



| Observation | R_1 ($k\Omega$) | R_2 ($k\Omega$) | R_3 ($k\Omega$) | I_3' (mA) | I_3'' (mA) | $I_3' + I_3''$ (mA) | I_3 (mA) |
|-------------|------------------------|------------------------|------------------------|----------------|-----------------|------------------------|---------------|
| Simulation | 1.2 | 2.2 | 3.3 | 0.79 | 0.61 | 1.40 | 1.40 |
| Theoretical | 1.2 | 2.2 | 3.3 | 0.7936 | 0.60606 | 1.39971 | 1.39971 |

⑥ Discussion:

For both of the circuits, if we keep both power sources alive and calculate I_3 , then it will be equal to the added value of I_3' and

I_3'' (from the above Superposition circuits where first E_1 was active only and then E_2 was active only). So, we can say with absolute certainty that the Superposition Principle is accurate and verified. i.e. it is verified twice.