East West University

LAB REPORT

Course Code and Name: CSE209 ; ELECTRICAL CIRCUIT	
Experiment no: 05 **Group no: 01**	
Experiment name: Verification of Superposition Theorem	
Name of students & Id:	
1. B M Sharhia Alam	**ID:** 2021-3-60-016
2. Sidratul Moontaha	**ID:** 2021-3-60-048
3. Antara Sarkar Rupa	**ID:** 2021-3-60-056
Course Instructor information: M Saddam Hossain Khan(SHK) Senior Lecturer Department of Computer Science and Engineering East West University	
Date of Report Submitted: 3 December ,2022	

Abstract:

Superposition theorem works for linear circuits. The superposition theorem states that if a linear circuit contains more than one source, the voltage across or the current through any element may be determined by algebraically adding the contribution of each source acting alone with other sources remaining inactive. A voltage source is made inactive by setting its voltage value to zero. In this experiment we verify the superposition theorem using PSpice simulation. For this, we use four circuit and some fixed resistors and voltage sources.

OBJECTIVE:

To obtain knowledge and verify the superposition theorem theoretically and using PSpice simulation.

Circuit diagrams:

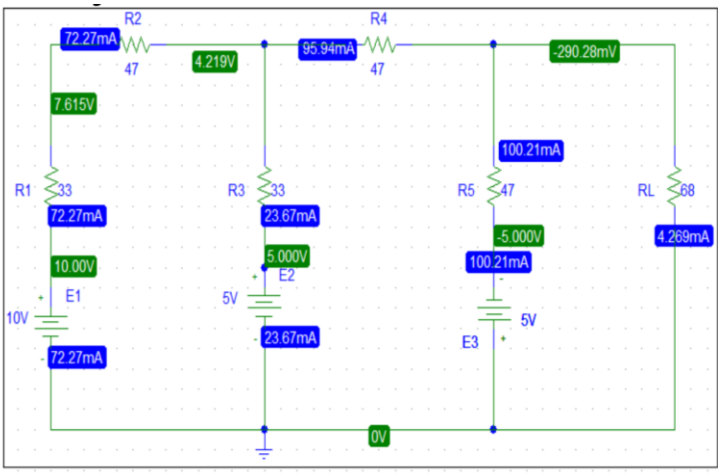


Figure 1: Circuit with all sources active

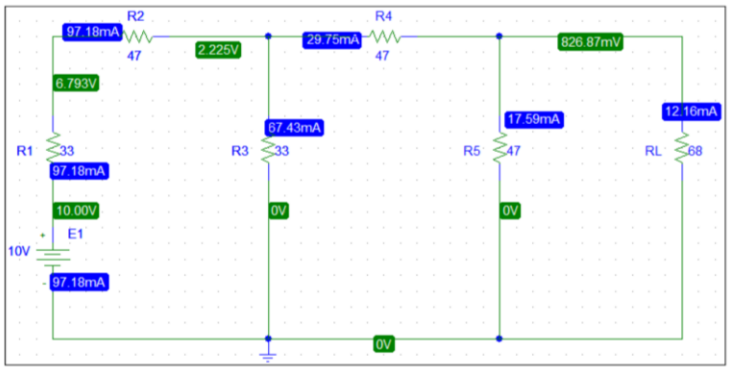


Figure 2: Circuit with 10V source active.

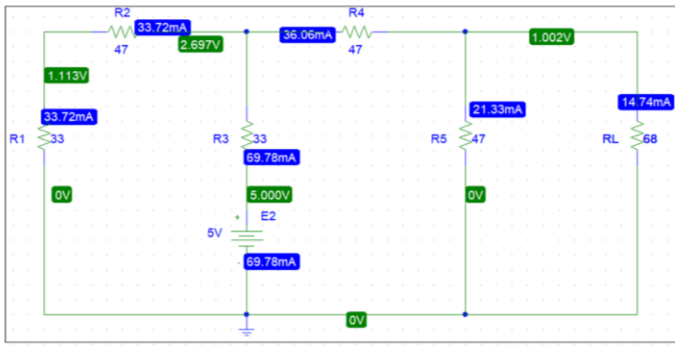


Figure 3: Circuit with 5V source active

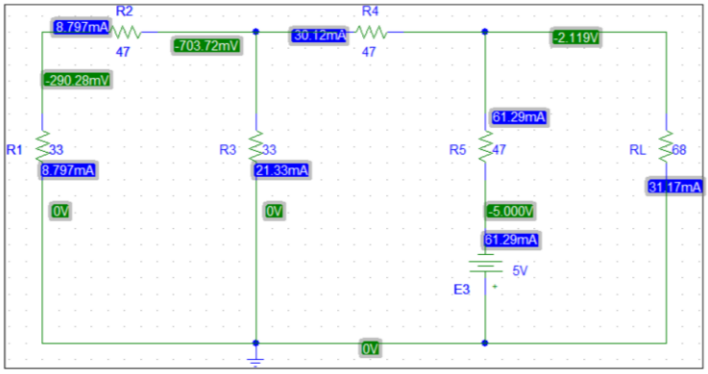
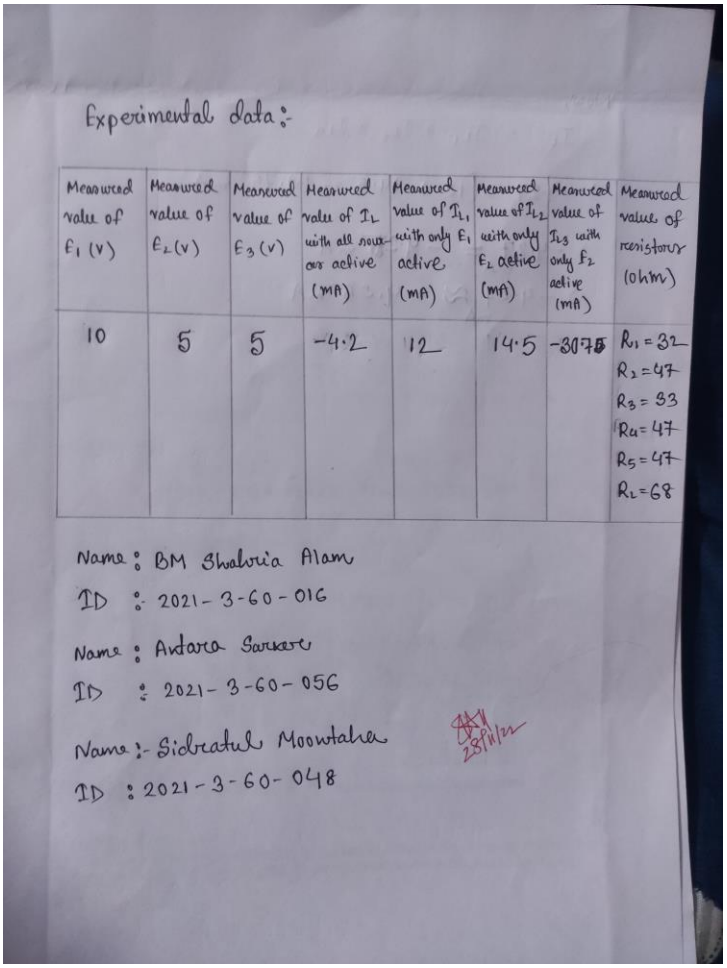


Figure 4: Circuit with 5V source active.

Experimental Datasheet:



Experimental data:-

Measured value of E_1 (V)	Measured value of E_2 (V)	Measured value of E_3 (V)	Measured value of I_L with all sources active (mA)	Measured value of I_{L_1} with only E_1 active (mA)	Measured value of I_{L_2} with only E_2 active (mA)	Measured value of I_{L_3} with only E_3 active (mA)	Measured value of resistors (ohm)
10	5	5	-4.2	12	14.5	-30.75	$R_1 = 32$ $R_2 = 47$ $R_3 = 33$ $R_4 = 47$ $R_5 = 47$ $R_L = 68$

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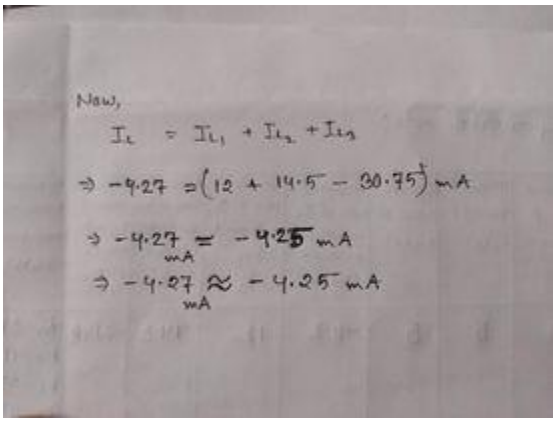


Now,

$I_L = I_{L_1} + I_{L_2} + I_{L_3}$

$\Rightarrow -4.27 = (12 + 14.5 - 30.75)$ mA

$\Rightarrow -4.27 \underset{mA}{=} -4.25$ mA

$\Rightarrow -4.27 \underset{mA}{\approx} -4.25$ mA

Pre-lab report:

Name: Sidratul Moontaha

ID: 2021-3-60-048

Experiment number: 05

1.

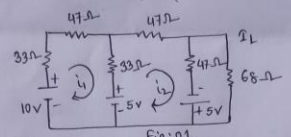


Fig: 01

KVL at mesh 1,

$$-10 + 33i_4 + 47i_1 + 33(i_1 - i_2) + 5 = 0$$

$$\Rightarrow 113i_1 - 33i_2 = 5 \quad \text{—(1)}$$

KVL at mesh 2,

$$-5 + 33(i_2 - i_1) + 47i_2 + 47(i_2 - i_3) - 5 = 0$$

$$\Rightarrow -33i_1 + 127i_2 - 47i_3 = 10 \quad \text{—(2)}$$

KVL at mesh 3,

$$5 + 47(i_3 - i_2) + 68i_3 = 0$$

$$\Rightarrow -47i_2 + 115i_3 = -5 \quad \text{—(3)}$$

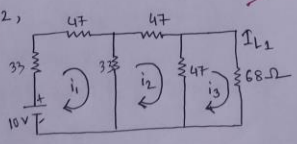
$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & 5 \\ -33 & 127 & 10 \\ 0 & -47 & -5 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(-635+470)+33(165)+5(1551)}{113(14605-2209)+33(-3795)+0}$$

$$= -4.269 \times 10^{-3} A$$

$$= -4.269 \text{ mA}$$

$\therefore I_L = i_3 = -4.26 \text{ mA}$

For fig 02,



KVL at mesh 1,

$-10 + 33i_1 + 47i_1 + 33(i_1 - i_2) = 0$

$\Rightarrow 113i_1 - 33i_2 = 10$ —(1)

KVL at mesh 2,

$33(i_2 - i_1) + 47i_2 + 47(i_2 - i_3) = 0$

$\Rightarrow -33i_1 + 127i_2 - 47i_3 = 0$ —(2)

KVL at mesh 3,

$47(i_3 - i_2) + 68i_3 = 0$

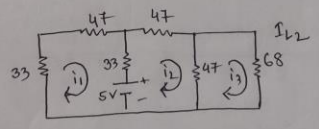
$\Rightarrow -47i_2 + 115i_3 = 0$ —(3)

$$i_3 = \frac{\begin{vmatrix} 113 & -33 & 10 \\ -33 & 127 & 0 \\ 0 & -47 & 0 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{10(1551)}{1275513} = 0.012\ A$$

$= 12.16\ mA$

$\therefore I_{L_1} = 12.16\ mA$

For fig 3,



I_{L_2}

KVL at mesh 1,

$113i_1 - 33i_2 = -5$ —(1)

KVL at mesh 2,

$-33i_1 + 127i_2 - 47i_3 = 5$ —(2)

KVL at mesh 3,

$-47i_2 + 115i_3 = 0$ —(3)

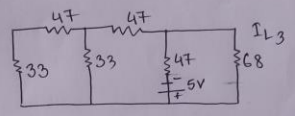
$$i_3 = \frac{\begin{vmatrix} 113 & -33 & -5 \\ -33 & 127 & 5 \\ 0 & -47 & 0 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(235) - 5(1551)}{1275513}$$

$$= \frac{18800}{1275513} = 0.0147A$$

$$= 14.74 mA$$

$\therefore I_{L_2} = 14.74$ mA

For fig 04,



KVL at mesh 1,

$$113i_1 - 33i_2 = 0 \quad \text{—①}$$

KVL at mesh 2, $-33i_1 + 127i_2 - 47i_3 = 5$ —②

KVL at mesh 3,

$$-47i_2 + 115i_3 = -5 \quad \text{—③}$$

$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & 5 \\ 0 & -47 & -5 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(-635+235) + 3(1551)}{1275513}$$

$$= -0.0311A$$

$$= -31.17 mA$$

$\therefore I_{L_1} + I_{L_2} + I_{L_3}$

$= 12.16 + 14.74 + (-31.17) = -4.27$ mA

$I_L = -4.269$ mA

$\therefore I_L = I_{L_1} + I_{L_2} + I_{L_3}$

So, Superposition theorem has theoritically proved.

—o—

Name: Antara Sarkar Rupa.

ID : 2021-3-60-056

Group no: 01 Experiment No: 04

1. Theoritically calculate the values of I_L, I_{L_1}, I_{L_2} and I_{L_3} of the circuits of figures 1 through 4. From the calculated values, show that the superposition theorem holds that is $I_L = I_{L_1} + I_{L_2} + I_{L_3}$.

⇒

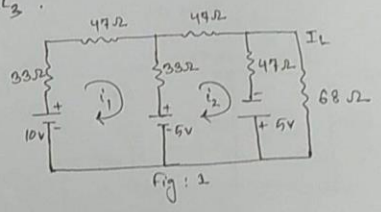


Fig : 1

KVL at mesh 1:

$-10 + 33i_1 + 47i_1 + 33(i_1 - i_2) + 5 = 0$

$\Rightarrow 113i_1 - 33i_2 = 5$ ——— ①

KVL at mesh 2,

$-5 + 33(i_2 - i_1) + 47i_2 + 47(i_2 - i_3) - 5 = 0$

$\Rightarrow -33i_1 + 127i_2 - 47i_3 = 10$ ——— ②

KVL at mesh 3,

$5 + 47(i_3 - i_2) + 68 i_3 = 0$

$\Rightarrow -47 i_2 + 115 i_3 = -5$ ——— ③

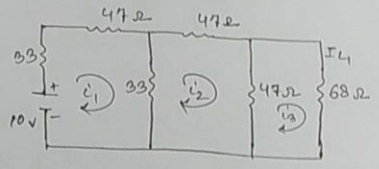
$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & 5 \\ -33 & 127 & 10 \\ 0 & -47 & -5 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(-635-470)+33(165+0)+5(1551-0)}{113(14605-2209)+33(-3795)+0}$$

$= -4.269 \times 10^{-3}$ A

$= -4.269$ mA

$\therefore I_L = i_3 = -4.26$ mA.

For, fig 02,



KVL at mesh 1:

$-10 + 33 i_1 + 47 i_1 + 33(i_1 - i_2) = 0$

$\Rightarrow 133 i_1 - 33 i_2 = 10$ ——— ①

KVL at mesh 2:

$33(i_2 - i_1) + 47 i_2 + 47(i_2 - i_3) = 0$

$\Rightarrow 33 i_1 + 127 i_2 - 47 i_3 = 0$ ——— ②

③

KVL at mesh 3 :

$47(i_3 - i_2) + 68 i_3 = 0$

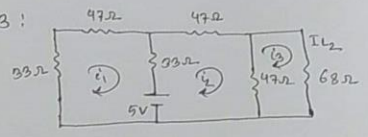
$\Rightarrow -47 i_2 + 115 i_3 = 0$ ——— ③

$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & 10 \\ -33 & 127 & 0 \\ 0 & -47 & 0 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{10(1551)}{1275513} = 0.012\ A$$

$= 12.16\ mA$

$\therefore I_{L_1}$

for fig 3 :



KVL at mesh 1 :

$113 i_1 - 33 i_2 = -5$ ——— ①

KVL at mesh 2 :

$-33 i_1 + 127 i_2 - 47 i_3 = 5$ ——— ②

KVL at mesh 3 :

$-47 i_2 + 115 i_3 = 0$ ——— ③

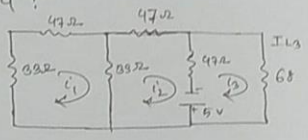
$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & -5 \\ -33 & 127 & 5 \\ 0 & -47 & 0 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(235) - 5(1551)}{1275513}$$

$$= \frac{18800}{1275513} = 0.0147\ A$$

$= 14.74\ mA$.

$\therefore I_{L_2} = 14.74\ mA$

for fig 04 :



KVL at mesh 1,

$$113 i_1 - 33 i_2 = 0 \quad \text{---(1)}$$

KVL at mesh 2,

$$-33 i_1 + 127 i_2 - 47 i_3 = 5 \quad \text{---(2)}$$

KVL at mesh 3,

$$-47 i_2 + 115 i_3 = -5 \quad \text{---(3)}$$

$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & 5 \\ 0 & -47 & -5 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(-635+235)+3(1651)}{1275513}$$

$$= -0.0311\ A$$

$$= -31.17\ mA.$$

$\therefore I_{L_1} + I_{L_2} + I_{L_3}$

$= 12.16 + 14.74 + (-31.17) = -4.27\ mA.$

$I_L = -4.27\ mA.$

$\therefore I_L = I_{L_1} + I_{L_2} + I_{L_3}$

So, super position theorem has theoritically proved.

Name: B M Shahriia Alam
ID: 2021-3-60-016
Course: 209(3)
Lab: 3
Experiment number: 05

Lab- 3 Pree lab report

Q. Theoretically calculate the values of I_L, I_{L1}, I_{L2} and I_{L3} of the circuits of Figures 1 through 4. From the calculated values, show that the superposition theorem holds, that is $I_L = I_{L1} + I_{L2} + I_{L3}$

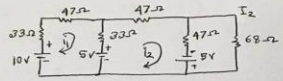


Fig: 01

KVL at mesh 1,

$-10 + 33 i_1 + 47 i_1 + 33 (i_1 - i_2) + 5 = 0$

$\Rightarrow 113 i_1 - 33 i_2 = 5 \quad \cdots\cdots (i)$

KVL at mesh 2,

$-5 + 33 (i_2 - i_1) + 47 i_2 + 47 (i_2 - i_3) - 5 = 0$

$\Rightarrow -33 i_1 + 127 i_2 - 47 i_3 = 10 \quad \cdots\cdots (ii)$

KVL at mesh 3,

$5 + 47 (i_3 - i_2) + 68 i_3 = 0$

$\Rightarrow -47 i_2 + 115 i_3 = -5 \quad \cdots\cdots (iii)$

$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & 5 \\ -33 & 127 & 10 \\ 0 & -47 & -5 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(-635 + 470) + 33 \times 165 + 5(1551)}{113(14605 - 2209) + 33(-3795)}$$

$= -4.269 \times 10^{-3} A$

$= -4.269 \text{ mA}$

$\therefore I_1 = i_3 = -4.26 \text{ mA}$

For fig 02,

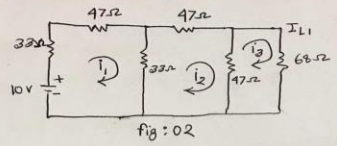


fig : 02

KVL at mesh 1;

$$-10 + 33i_1 + 47i_1 + 33(i_1 - i_2) = 0$$

$$\Rightarrow 113\, i_1 - 33 i_2 = 10 \quad \cdots\cdots (1)$$

KVL at mesh 2;

$$33(i_2 - i_1) + 47 i_2 + 47(i_2 - i_3) = 0$$

$$\Rightarrow -33 i_1 + 127 i_2 - 47 i_3 = 0 \quad \cdots\cdots (2)$$

KVL at mesh 3;

$$47(i_3 - i_2) + 68 i_3 = 0$$

$$\Rightarrow -47 i_2 + 115 i_3 = 0 \quad \cdots\cdots (3)$$

$$\therefore i_3 = \frac{\begin{vmatrix} 113 & -33 & 10 \\ -33 & 127 & 0 \\ 0 & -47 & 0 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{10(15551)}{1275513} = 0.012\ A$$

$$= 12.16\ mA$$

$$\therefore I_{L_1} = 12.16\ mA$$

For fig 03,

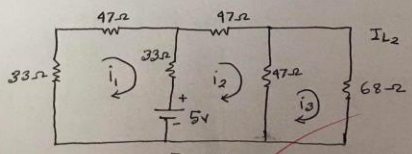


Fig : 03

KVL at mesh 1;

$$113 i_1 - 33 i_2 = -5 \quad \cdots\cdots (1)$$

KVL at mesh 2;

$$-33 i_1 + 127 i_2 - 47 i_3 = 5 \quad \cdots\cdots (2)$$

KVL at mesh 3;

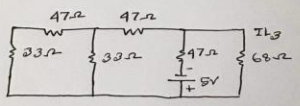
$$-47 i_2 + 115 i_3 = 0 \quad \cdots\cdots (3)$$

$$i_3 = \frac{\begin{vmatrix} 113 & -33 & -5 \\ -33 & 127 & 5 \\ 0 & -47 & 0 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(235) - 5(1851)}{1275513}$$

$$= 0.0147 \text{ A}$$

$$= 14.74 \text{ mA}$$

For fig 04;



KVL at mesh 1;

$$113 i_1 - 33 i_2 = 0 \quad \cdots\cdots (1)$$

KVL at mesh 2;

$$-33 i_1 + 127 i_2 - 47 i_3 = 5 \quad \cdots\cdots (2)$$

KVL at mesh 3;

$$-47 i_2 + 115 i_3 = -5 \quad \cdots\cdots (3)$$

$$i_3 = \frac{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & 5 \\ 0 & -47 & -5 \end{vmatrix}}{\begin{vmatrix} 113 & -33 & 0 \\ -33 & 127 & -47 \\ 0 & -47 & 115 \end{vmatrix}} = \frac{113(-635+235)+33(1651)}{1275513}$$

$$= -0.0311 \text{ A}$$

$$= -31.17 \text{ mA}$$

$$\therefore I_{L_1} + I_{L_2} + I_{L_3}$$

$$= 12.16 + 14.74 + (-31.17)$$

$$= -4.27 \text{ mA}$$

$$I_L = -4.269 \text{ mA}$$

$$\therefore I_L = I_{L_1} + I_{L_2} + I_{L_3}$$

∴ So, supperposition theorem has theoritically proved.

Equipments and Components Needed:

1. DC power supply
2. Trainer board
3. DC ammeter
4. Multimeter
5. Resistors 33Ω (two), 47Ω (three), 68Ω (one)
6. Breadboard
7. Connecting wires

Lab Procedure:

1. Measure the resistance values of the given resistors and record them in Table 1.
2. Construct the circuit with all voltage sources active as shown in Figure. 1. For the E1 = 10V source, use DC power supply. For the E2 = 5V and E3 = 5V sources, use the fixed voltage sources of the trainer board (be careful of the polarity of the voltage sources). Measure the values of the voltage sources and record them in Table 1. Measure IL and record it in Table 1.
3. Construct the circuit with only voltage source E1 active as shown in Figure 2. This may be done by removing the voltage sources E2 and E3 from the circuit and replacing them with short circuits. Caution: Do not try to replace any voltage source with a short circuit by directly connecting a wire across it. This will burn the trainer board. Measure the value of IL1 and record it in Table 1. This is the current through the RL = 68Ω resistor when only the E1 = 10V source is active.
4. Construct the circuit with only voltage source E2 active as shown in Figure 3. Measure the current IL2 and record it in Table 1. This is the current through the RL = 68Ω resistor when only the E2 = 5V source is active.
5. Construct the circuit with only voltage source E3 active as shown in Figure 4. Measure the current IL3 and record it in Table 1. This is the current through the RL = 68Ω resistor when only the E3 = 5V source is active (be careful of the polarity of this source).
6. From the experimental data, show that the superposition theorem holds, that is, IL = IL1 + IL2 + IL2.
7. Have the datasheet signed by your instructor.

Result & Discussion:

By doing this experiment, we slightly widen our knowledge that we gained from the previous experiment. Here, we are able to simulate our circuits via PSpice and test the results. Previously we had tested our circuits practically. As a result, this is more efficient.

Conclusion:

While doing the experiments, the readings were taken very carefully. Though there is some difference between calculated value and PSpice value, at the end of the experiment we finally gained practical knowledge about Superposition theorem.

Reference:

[1] Lab manual. [2] Academia.