LAB Assignment : 04

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Course : CSE250

Section : 09

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Experiment no : 03

Experiment name : Varification of superposition principle.

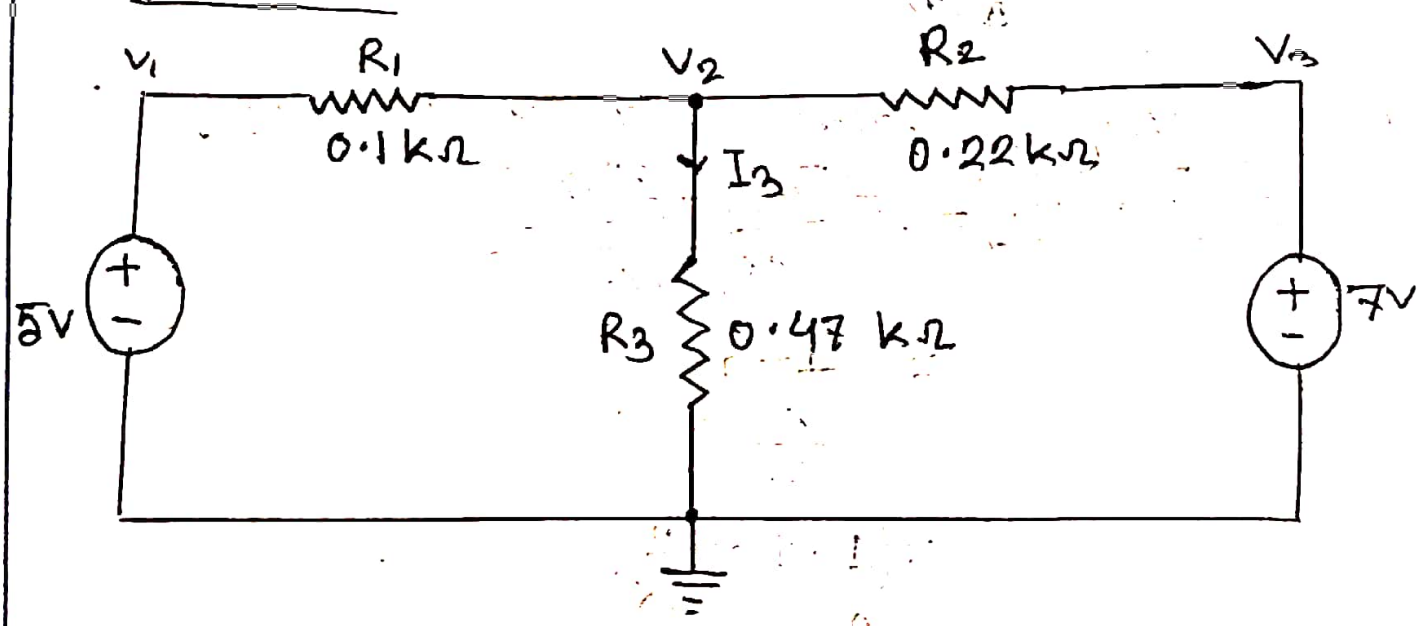
Experiment No: 03

Name of the Experiment: Verification of Superposition principle.

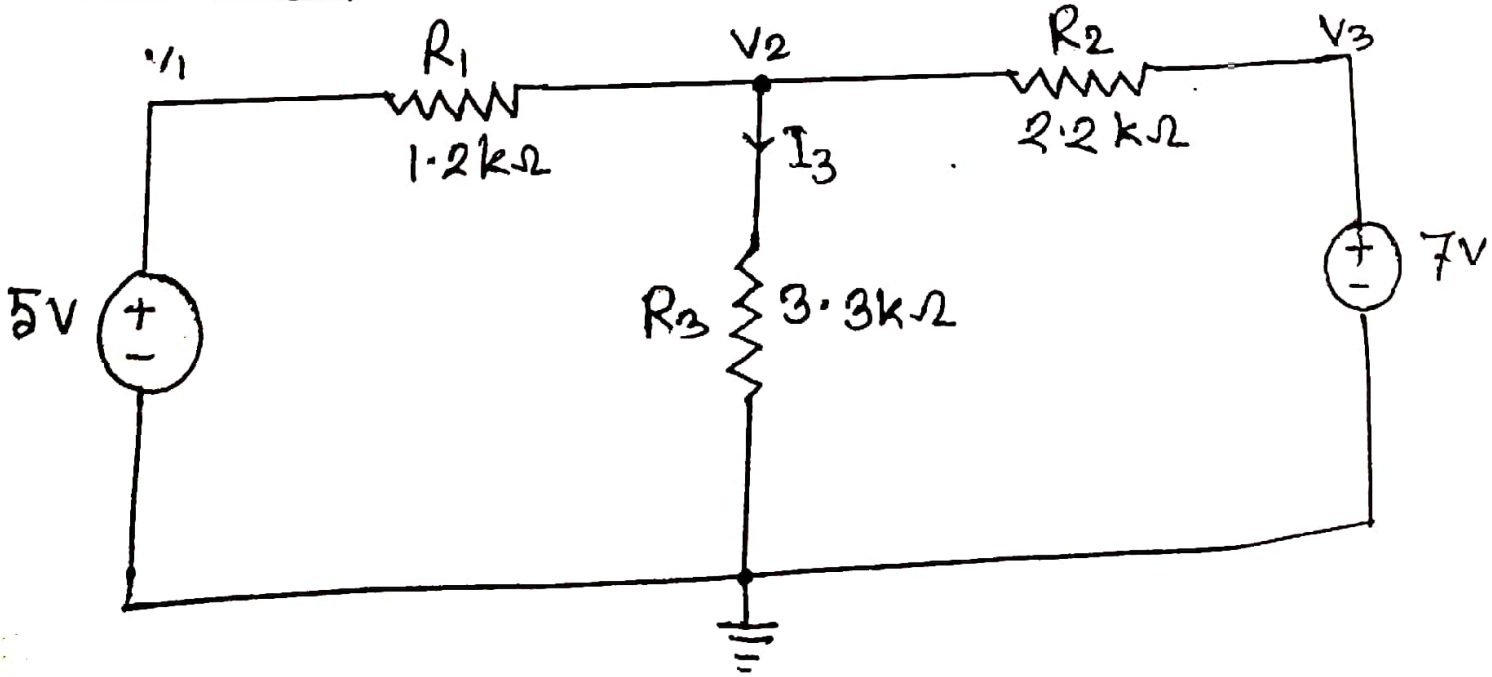
Objective: The experiment is to verify experimentally the Superposition theorem which is an analytical technique of determining currents in a circuit with more than one emf source.

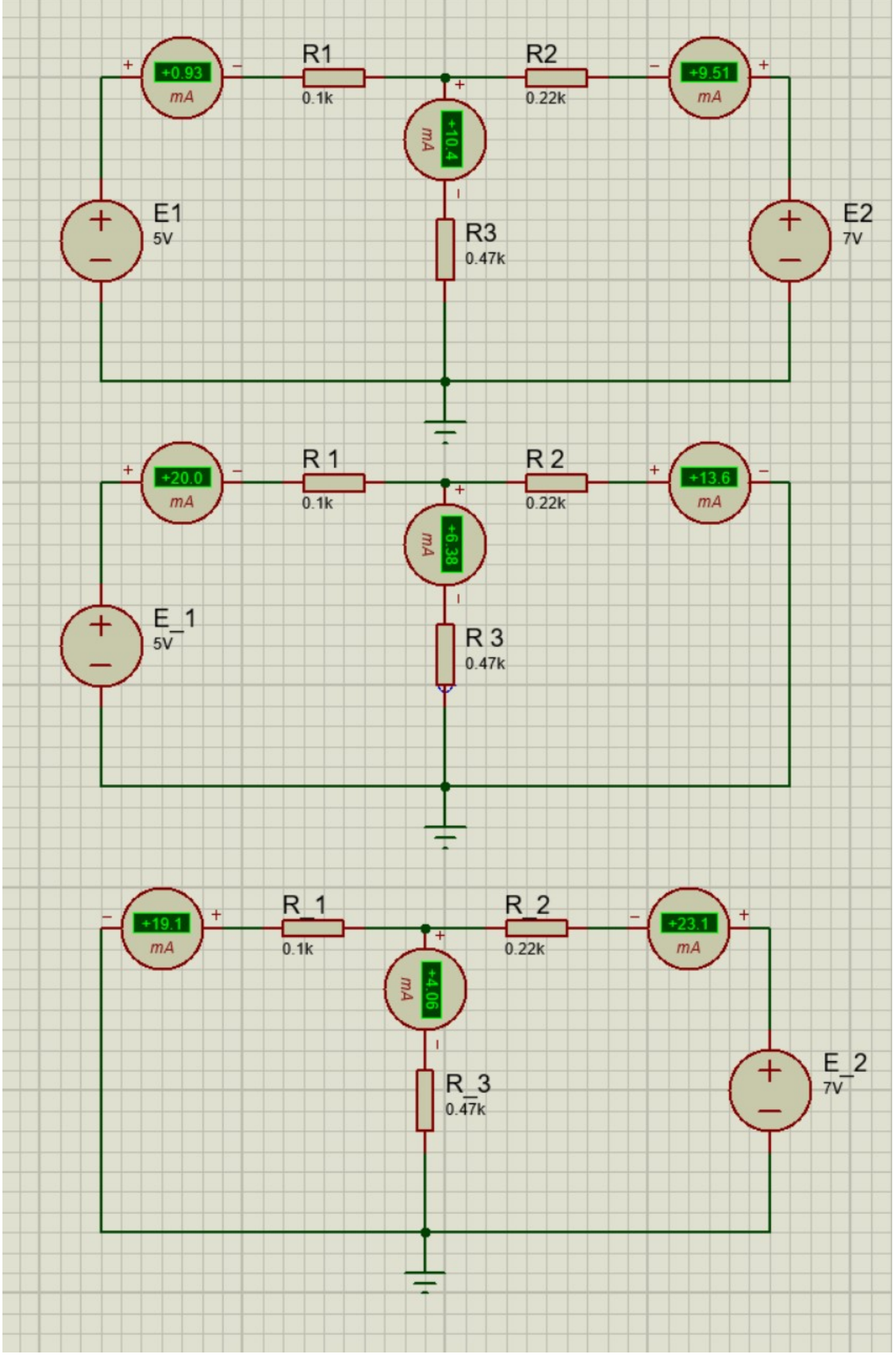
Circuit Diagram:

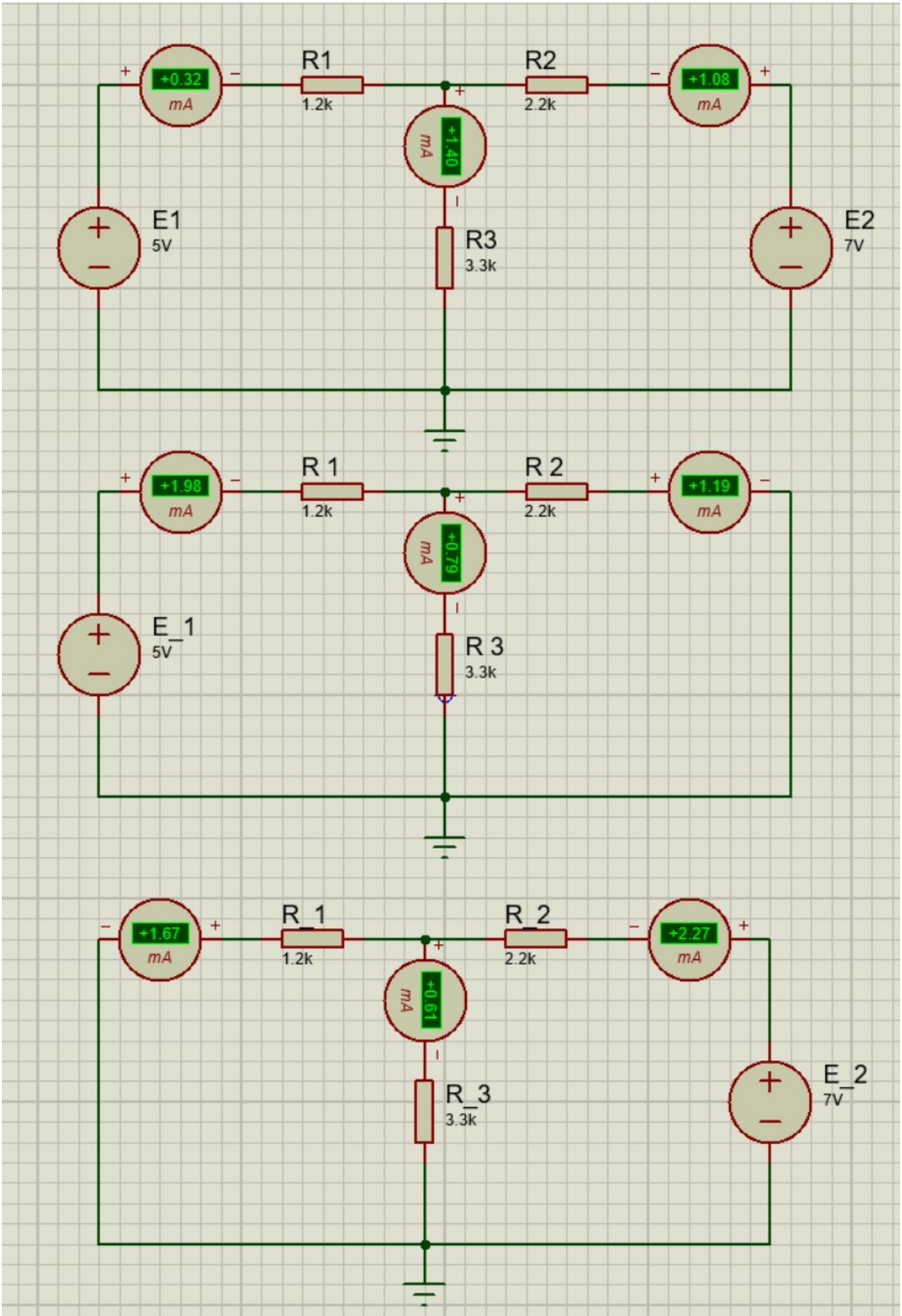
Circuit 01:



Circuit 02:




+0.93
mA
R1
0.1k
R2
0.22k
+9.51
mA
+10.4
mA
E1
5V
R3
0.47k
E2
7V
+20.0
mA
R 1
0.1k
R 2
0.22k
+13.6
mA
+6.38
mA
E_1
5V
R 3
0.47k
+19.1
mA
R_1
0.1k
R_2
0.22k
+23.1
mA
+4.06
mA
R_3
0.47k
E_2
7V


+0.32
mA
R1
1.2k
+1.40
mA
R2
2.2k
+1.08
mA
E1
5V
R3
3.3k
E2
7V
+1.98
mA
R 1
1.2k
+0.79
mA
R 2
2.2k
+1.19
mA
E_1
5V
R 3
3.3k
+1.67
mA
R_1
1.2k
+0.61
mA
R_2
2.2k
+2.27
mA
R_3
3.3k
E_2
7V

Result / Analysis :

Circuit 01 : when $E_1 = 5V$ and $E_2 = 7V$

$V_1 = 5$

$V_2 = 7$

Also, $R_1 = 0.1\,k\Omega = 100\,\Omega$; $R_2 = 0.22k\,k\Omega = 220\,\Omega$

$R_3 = 0.47k\Omega = 470\,\Omega$

Now,

$$V_2\left(\frac{1}{100} + \frac{1}{220} + \frac{1}{470}\right) - \frac{5}{100} - \frac{7}{220} = 0$$

$$\Rightarrow 0.0167V_2 - 0.0818 = 0$$

$$\Rightarrow V_2 = 4.907V$$

So, $I_3 = \frac{V_2 - 0}{R_3} = \frac{4.907}{470} = 0.0104A = 10.4\ mA$

when, $E_1 = 5V$ but $E_2 = 0V$,

$V_1 = 5$.

Now,

$$V_2 \cdot \left(\frac{1}{100} + \frac{1}{220} + \frac{1}{470}\right) - \frac{5}{100} = 0$$

$$\Rightarrow 0.01667V_2 - 0.05 = 0$$

$$\Rightarrow V_2 = 2.998\ V.$$

So, $I_3' = \frac{V_2 - 0}{R_3} = \frac{2.998}{470} = 6.38\ mA$

when $E_1 = 0V$; $E_2 = 7V$; $V_3 = 7$

$$V_2 \cdot \left(\frac{1}{100} + \frac{1}{220} + \frac{1}{470}\right) - \frac{7}{100} = 0$$

$$\Rightarrow 1.667V_2 - 0.0318 = 0$$

$$\Rightarrow V_2 = 1.908\ V$$

So, $I_3'' = \frac{V_2 - 0}{R_3} = \frac{1.908}{470} = 4.060\ mA$.

Table for circuit 01:

Observation	R_1 (kΩ)	R_2 (kΩ)	R_3 (kΩ)	I_3' (mA)	I_3'' (mA)	$I_3' + I_3''$ (mA)	I_3 (mA)
Simulation	0.1	0.22	0.47	6.38	4.06	10.44	10.4
Theoritical	0.1	0.22	0.47	6.38	4.06	10.44	10.4

So, the theoritical results and the simulation results are verified.

Circuit 2:

when $E_1 = 5V$ and $E_2 = 7V$

$V_1 = 5$; $V_3 = 7$

$R_1 = 1.2k\Omega = 1200\Omega$; $R_2 = 2.2k\Omega = 2200\Omega$

Now, $R_3 = 3.3k\Omega = 3300\Omega$

$$V_2\left(\frac{1}{1200} + \frac{1}{2200} + \frac{1}{3300}\right) - \frac{5}{1200} - \frac{7}{2200} = 0$$

$$\Rightarrow 0.00159V_2 - 0.00416 - 0.00318 = 0$$

$$\Rightarrow V_2 = 4.617V$$

$$\therefore I_3 = \frac{V_2 - 0}{R_3} = \frac{4.617}{3300} = 0.001398A = 1.40mA$$

when, $E_1 = 5V$ but $E_2 = 0V$

$V_1 = 5$

Now,

$$V_2\left(\frac{1}{1200} + \frac{1}{2200} + \frac{1}{3300}\right) - \frac{5}{1200} = 0$$

$$\Rightarrow 0.00159V_2 - 0.00416 = 0$$

$$\Rightarrow V_2 = 2.616V$$

$$\therefore I_3' = \frac{V_2 - 0}{R_3} = \frac{2.616}{3300} = 0.000792A = 0.79mA.$$

when, $E_1 = 0V$ but $E_2 = 7V$

$V_3 = 7$

Now,

$$V_2\left(\frac{1}{1200} + \frac{1}{2200} + \frac{1}{3300}\right) - \frac{7}{2200} = 0$$

$$\Rightarrow 0.001159\, V_2 - 0.00318 = 0$$

$$\Rightarrow V_2 = 2V$$

$$\therefore I_3'' = \frac{V_2 + 0}{R_3} = \frac{2}{3300} = 0.000606A = 0.61mA.$$

Table for circuit-2:

Observation	R_1 (KΩ)	R_2 (KΩ)	R_3 (KΩ)	I_3 (mA)	I_3' (mA)	$I_3' + I_3''$ (mA)	I_3 (mA)
Simulation	1.2	2.2	3.3	0.79	0.60	1.4	1.40
Theoritical	1.2	2.2	3.3	0.79	0.61	1.4	1.40

So, the theoritical results and the simulation results are verified.

Question-answer:

- **Linear Element**: A linear relationship between voltage and current.

- **Linear circuit**: A linear circuit is one in which the electronic components values, such as resistance, capacitance, inductance, gain etc. are constant even in different voltage and current.

- **Nonlinear Element**: A nonlinear relationship between voltage an circuit.

- **Nolinear circuit**: A linear circuit is one in which the electronic components values such as resistance, capacitance, inductance, gain etc changes for different voltage and current.

(2) We know,

$$P = I^2R$$

$$\Rightarrow P = \frac{V^2}{R}$$

and,

$$V = IR$$

$$\Rightarrow I = \frac{V}{R}$$

It will give wrong result for superposition principle because the equation of power is quadratic.

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(3) By short ie circuiting, the independent voltage source deactivated and by open circuit independent current source deactivated.

Reasons are: Independent voltage circuit acts like a single node on the other hand independent current source acts like no nodes there.

Those indicates that in independent voltage source no voltage difference will show.
On contrary, in independent current source no current will flow.

④ From results and analysis part,
we get,
$I = 10.4\ mA$
[in circuit 01]
and,
$I = 1.40 mA$
[in circuit 2]

Discussion:
The results are the same of theoritical and simulation.
So, we can say that the theoritical part is correct. (prove).
There is no error in the experiment.
So, the result should be corrected.