EEL101: Basic Electrical Lab

Experiment No: 2 **Date:**

Batch No.		**Team Number**	
	Team Member 1	**Team Member 2**	**Team Member 3**
Name			
ID No			

Aim: To verify the superposition theorem for a given circuit.

Apparatus Required:

S.No.	Instrument	Range	Quantity
1.	Bread board		1
2.	Resistors	1kΩ, 330Ω, 220Ω	1 each
3.	Digital multimeter, Ammeter	(0-10mA)	1
4.	Connecting wires		As per need
5.	DC power, RPS (Regulated Power Supply)	(0-30V)	2

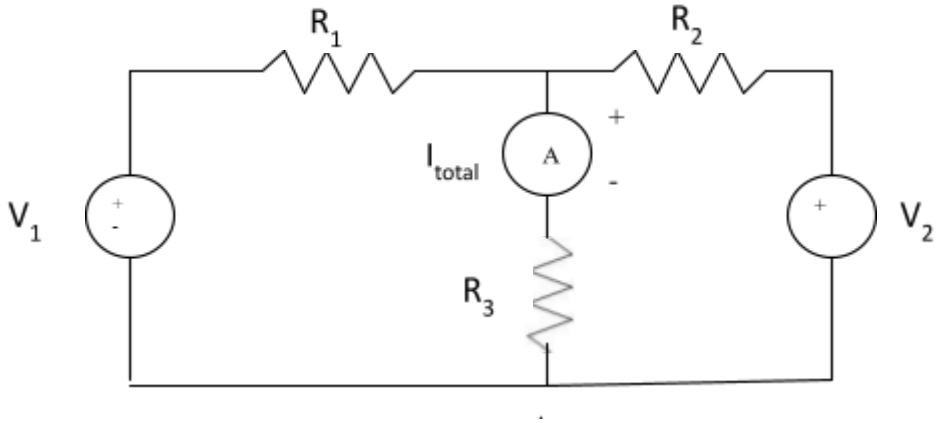
R1 = **R2 =** **R3 =**

Theory

Superposition Theorem:

Superposition theorem states that in a linear bilateral network containing more than one source, the current flowing through any branch is the algebraic sum of the current flowing through that branch when sources are considered one at a time and replacing other sources by their respective internal resistances.

Circuit Diagram:



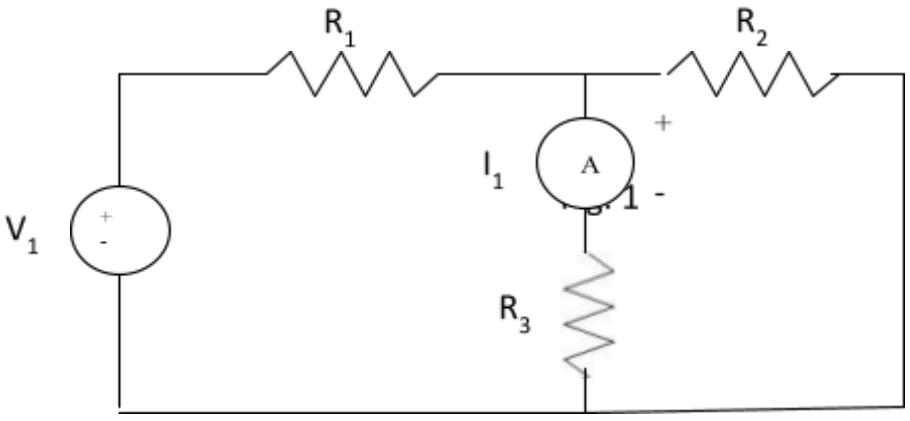


Fig. 2

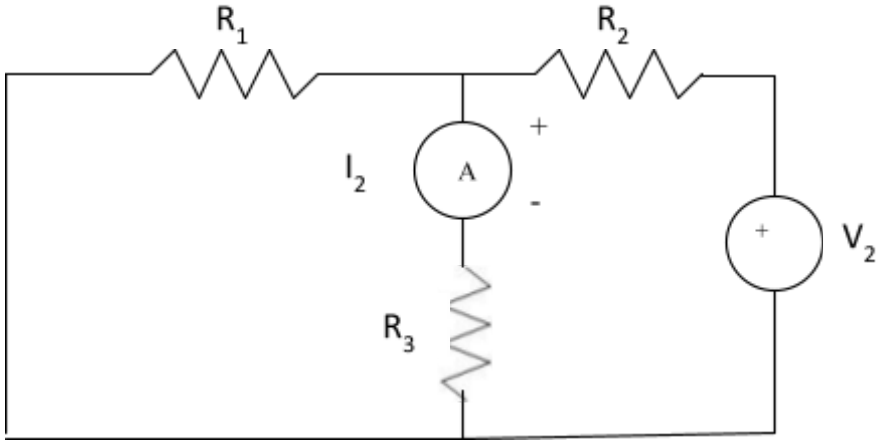


Fig. 3

Precautions:

1. Voltage control knob of RPS should be kept at the minimum position.
2. Current control knob of RPS should be kept at the maximum position.

Procedure:

1. Take all the components such as bread board, resistor, digital multimeter, DC power supply, connecting wire etc.
2. Connect the circuit as per the circuit diagram shown in Fig. 4.
3. Set a particular voltage value using RPS1 and RPS2 and note down the ammeter reading (I_{pr}).
4. Set the same voltage as in circuit 1 using RPS1 alone and disconnect RPS2 and short circuit the terminals and note the ammeter reading (I_1).
5. Repeat the same procedure with RPS2 and note down the ammeter reading (I_2).

6. Verify superposition theorem i.e. verify the following condition:
   $I_{total} = I_1 + I_2$
7. Calculate I_1 and I_2 theoretically and verify with the practical value.
8. Repeat steps 3 to 7 above for 10 different pairs of values of RPS1 and RPS2.

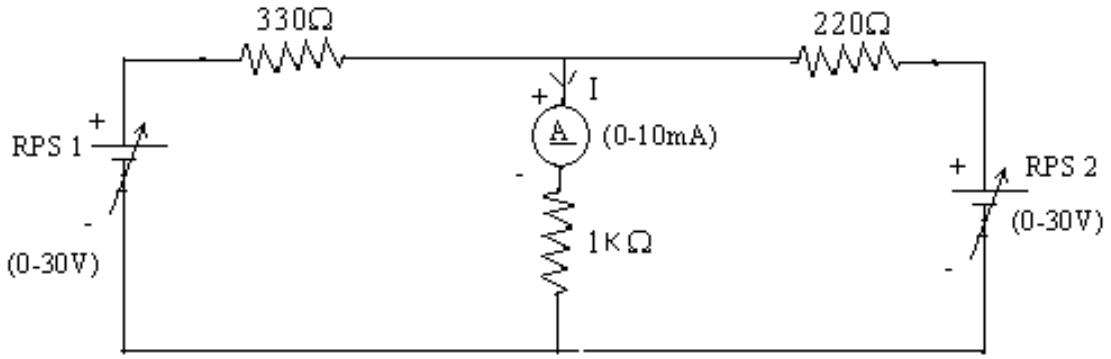


Figure 4: Circuit -1

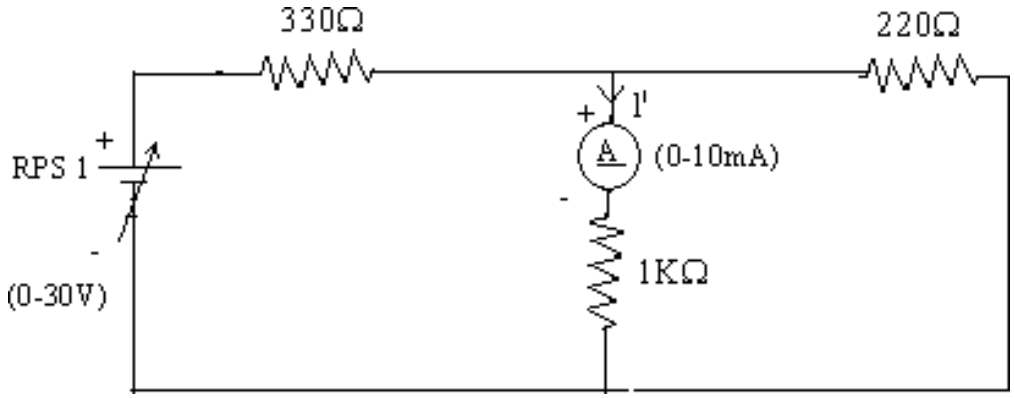


Figure 5: Circuit -2

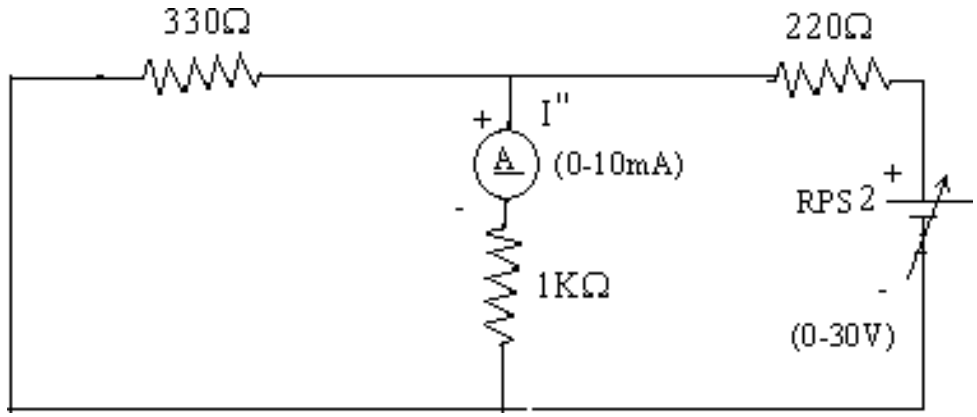


Figure 6: Circuit -3

Observation Table

S. No.	DC Sources (Volts)		Measured Values(s) (Current in mA)				Calculated Values(s) (Current in mA)				%Error (between measured I_{total} and ΣI_k)
	RPS1	RPS2	$\mathbf{I_{total}}$	I_1	I_2	$\mathbf{\Sigma I_k}$	$\mathbf{I_{total}}$	I_1	I_2	$\mathbf{\Sigma I_k}$	
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10											

Calculations:

1. Calculated I, I1 and I2 for circuits in Figures 1, 2 and 3, in terms of general variables, V1, V2, R1, R2 and R3.
2. Find percentage error between measured values of I_{total} and ΣI_k , similar to the following formula, taking I_{total} and ΣI_k in place of v_E and v_A respectively.

$$Absolute\ Error = |v_A - v_E|$$

$$Percentage\ Error = \left|\frac{v_A - v_E}{v_E}\right| \times 100\%$$

$$v_A = approximate\ (measured)\ value$$
$$v_E = exact\ value$$

Conclusion

The Superposition theorem has been verified both theoretically and practically.

Sample Post-Lab Questions

1. Using superposition theorem, predict the voltage across the load resistor for the experiment conducted.
2. When analyzing circuits, when is it better to use Superposition Theorem?
3. What is the internal resistance of an ideal voltage source?
4. Draw the circuit diagram of a practical voltage source with internal resistance.