**EXPERIMENT: Superposition Theorem**

**Aim**: Verification of Superposition theorem

**Apparatus**: Various power supply sources, resistances, breadboard, multimeter, connecting wires.

**Theory:** As per the superposition theorem, a linear bilateral network containing multiple voltage and current sources, the overall response at any point in the network is equal to the sum of the responses of each source considered separately with all other sources made inoperative and replaced by resistances equal to their internal resistance.

Consider the circuit shown in fig. 1 (a) consisting two voltage sources, namely, $V_1$ and $V_2$. Let the current through the resistor $R_1$ due to both the sources $V_1$ and $V_2$ be $I_1$. The circuit in fig. 1(b) only consists of voltage source $V_1$ and let the current through $R_1$ be $I_{11}$. The circuit in fig. 1(c) only consists of voltage source $V_2$ and let the current through $R_1$ be $I_{12}$. The mathematical equivalence of superposition theorem is given by eq. (1).

$$I_1 = I_{11} + +I_{12} \tag{1}$$

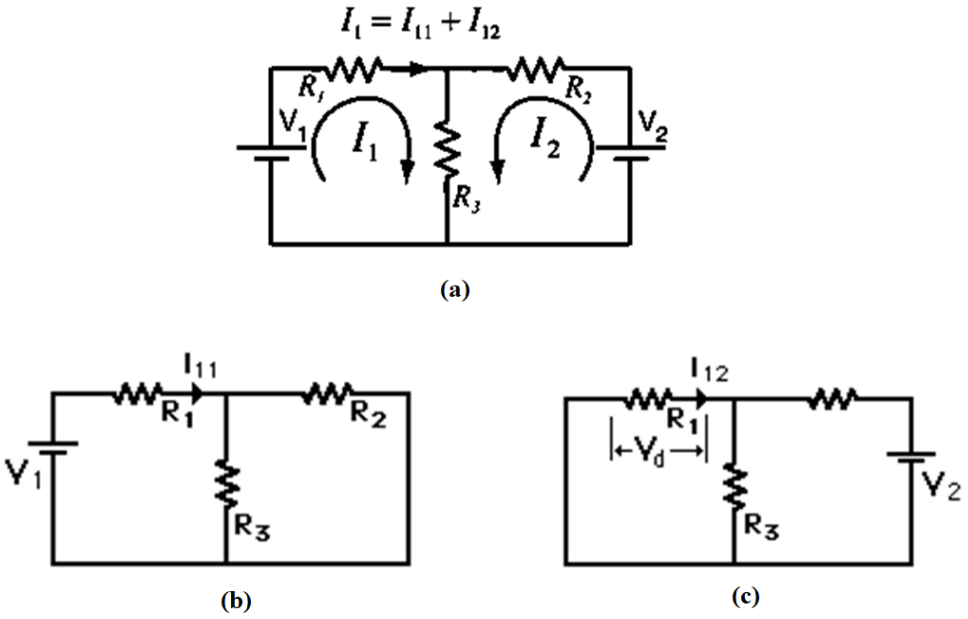


Fig. 1: (a) Circuit with two voltage sources with current direction, (b) considering voltage source $V_1$, (c) Considering voltage source $V_2$

The current $I_{11}$ is given by eq. (2).

$$I_{11} = \frac{V_1}{R_1 + R_2 \| R_3} \tag{2}$$

The current $I_{12}$ is given by eq. (3) and eq. (4).

$$I_{12} = \frac{-V_d}{R_1} \tag{3}$$

$$V_d = \frac{(R_1 \| R_3)V_2}{R_2 + R_1 \| R_3} \tag{4}$$

**Observations:**

| S.no. | $I_1$ (A) (measured) | $I_{11}$ (A) (measured) | $I_{12}$ (A) (measured) | $I_1 = I_{11} + I_{12}$ (A) |
|---|---|---|---|---|
| | | | | |

**Procedure**:

i) Connect the circuit on bread board as shown in fig.1
ii) For verifying theorem, consider one source at a time if you have multiple sources
iii) Connect the multimeter in series with branch.
iv) Consider source $V_1$ and remove the source $V_2$ and reconnect the circuit.
v) Measure "$I_{11}$"
vi) Consider source $V_2$ and remove the source $V_1$ and reconnect the circuit.
vii) Measure $I_{12}$

**Precautions**:

(i) Do not make interconnection on the board with mains switched ON.
(ii) As soon as mains is ON the reading in the meters must be zero. If the reading in the meters is not zero, check the meter.

**Result**: The net current I is the algebraic sum of $I_{11}$ and $I_{12}$ due to the individual voltage source taking one at a time $I = I_{11} + I_{12}$.