Lecture No. 9,10

"Superposition Theorem"

Superposition theorem :

In a network containing more than one source , the current which flows at any point is the sum of all currents which would flow through that point if each source was considered separately and all the other sources replaced for the time being by resistance equal to their internal resistances .

Example : For the circuit shown in fig. 1 , find the current in all branches , using Superposition theorem .

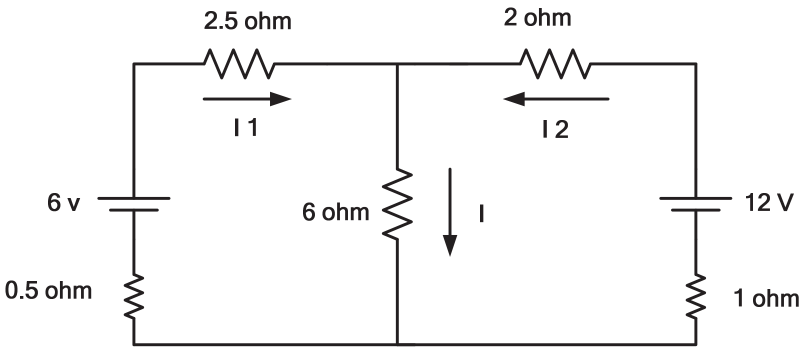
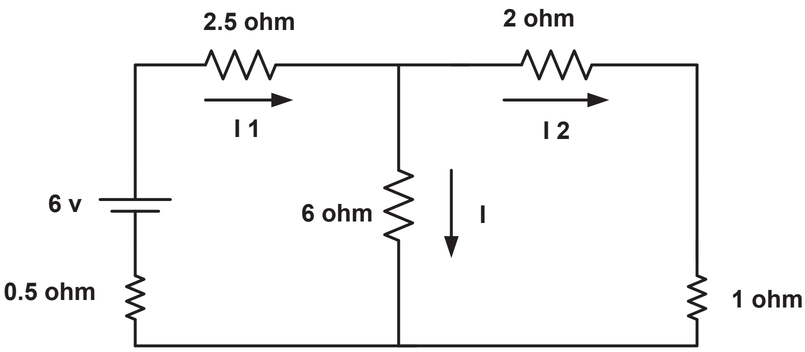


Fig 1

1. Consider 6 volt only , replaced 12 volt source by its internal resistance .



$$R_t = 2.5 + \frac{3 \times 6}{} + 0.5 = 5\ \Omega$$

3 + 6

$$I_1' = \frac{V_t}{R_t} = \frac{6}{5} = 1.2\ A \rightarrow$$

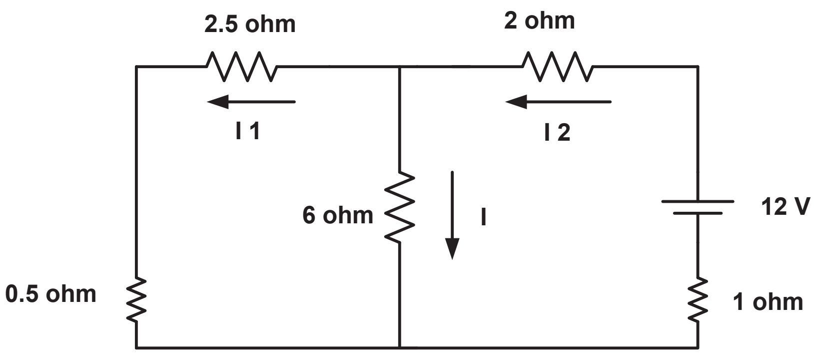
Using C.D.R :

$$I_2' = I_1' \times \frac{6}{6+3}$$

$$I_2' = 1.2 \times \frac{6}{9} = 0.8\ A \rightarrow$$

$$I' = I_1' - I_2' = 1.2 - 0.8 = 0.4\ A \downarrow$$

2. Consider 12 volt only , replaced 6 volt source by its internal resistance .



3 x 6

$$R_t = 2 + \frac{}{3 + 6} + 1 = 5\,\Omega$$

$$I_2 = \frac{V_t}{R_t} = \frac{12}{5} = 2.4\ A \leftarrow$$

Using C.D.R :

$$I_1 = I_2 \times \frac{6}{6 + 3}$$

$$I_1 = 2.4 \times \frac{6}{9} = 1.6\ A \leftarrow$$

$$I = I_2 - I_1 = 2.4 - 1.6 = 0.8\ A \downarrow$$

Now , take 6 volt and 12 volt sources in consideration :

$$I = I' + I'' = 0.4 + 0.8 = 1.2\ A \downarrow$$

$$I_1 = I_1'' - I_1' = 1.6 - 1.2 = 0.4\ A \leftarrow$$

$$I_2 = I_2'' - I_2' = 2.4 - 0.8 = 1.6\ A \leftarrow$$

Example : For the circuit shown in fig. 2 , find the current flows through 10 Ω resistor , using super position theorem .

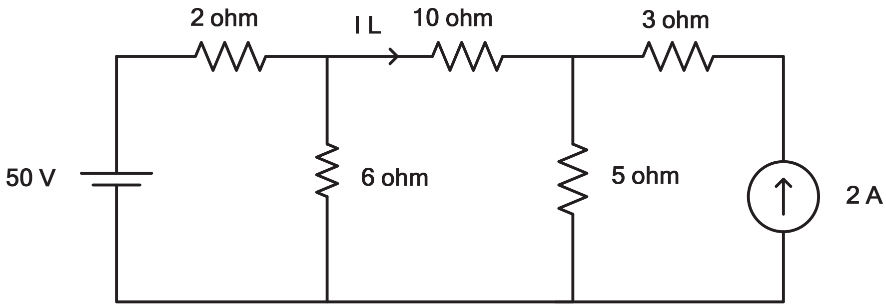
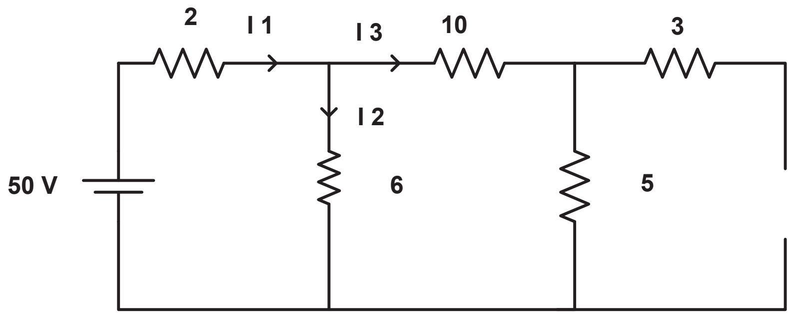


Fig 2

1. Consider 50 volt source only , replace 2 A current source by open circuit .



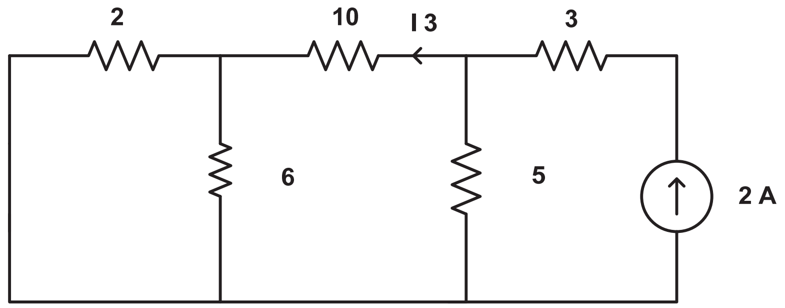
$$R_t = 2 + \frac{6 \times 15}{6 + 15} = 6.285\ \Omega$$

$$I_1 = \frac{V_t}{R_t} = \frac{50}{6.285} = 7.955\ A$$

Using C.D.R :

$$I_3 = I_1 \times \frac{6}{6+15} = 7.955 \times \frac{6}{21} = 2.272 \text{ A} \rightarrow$$

2. Consider 2 A current source only , replaced 50 volt source by short circuit .



$$\frac{2 \times 6}{2+6} + 10 = 11.5\ \Omega$$

It is clear that 11.5 Ω ⁄⁄ 5 Ω

Using C.D.R :

$$I_3' = 2 \times \frac{5}{5+11.5} = 0.606 \text{ A} \leftarrow$$

$$I_{10\Omega} = I_3 - I_3' = 2.272 - 0.606 = 1.66 \text{ A} \rightarrow$$